UNI S
AT N

Government
Documents
Bookstacks

JOURNALS CANNOT BE RENEWED

NOTICE: Return or renew all Library Materials! The *Minimum* Fee for each Lost Book is $50.00.

The person charging this material is responsible for its return to the library from which it was withdrawn on or before the **Latest Date** stamped below.

Theft, mutilation, and underlining of books are reasons for disciplinary action and may result in dismissal from the University.
To renew call Telephone Center, 333-8400

UNIVERSITY OF ILLINOIS LIBRARY AT URBANA-CHAMPAIGN

[redacted]

L161—O-1096

05
.20
F1

102-73

ENGINEERING

Engineer

March 1990

ROFESSIONAL BULLETIN RS

HERTZBERG — NEW METHOD, INC. EAST VANDALIA ROAD, JACKSONVILLE, ILL. 62650

DP-2

7300H TITLE NO.	ACCOUNT NO.	LOT AND TICKET NO.
E-0360.0000C	07200-102	CM 38-- 73 M

43-11 THE * ENGINEER *

(NP)

24 20-21*1990-91*
28 358.205*EN*

V.20-21*

CLOTH COLOR

ENX4
HEIGHT

0057 BU W/O V.20:4*BIND IN SLIP*

11 1/8

CHARGING INFORMATION SPECIAL WORK AND PREP.

STUBBING		FRONT COVER		HAND ADHESIVE	/	MAP POCKET PAPER	
HAND SEW		NO TRIM		LENGTHWISE		MAP POCKET CLOTH	
THRU SEW		PAGES LAMINATED		FOREIGN TITLE		SPECIAL WORK	
THRU SEW ON TAPE		EXTRA THICKNESS		LINES OF LETTERING		REMOVE TATTLE TAPE	

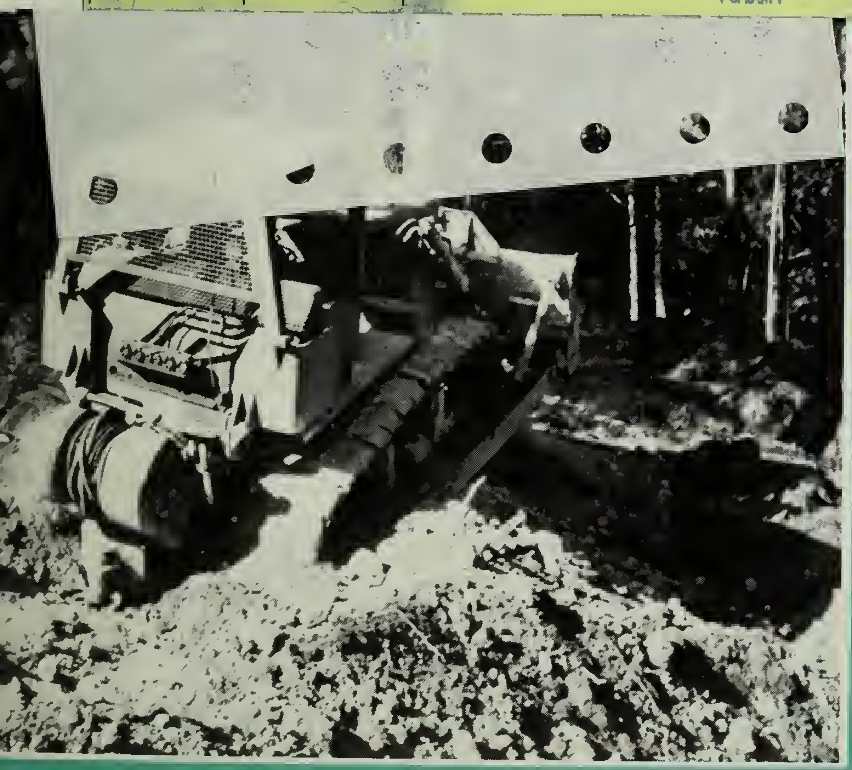
HEIGHT	PICA	WRAP
11	6	

7300H

ordan:
n the
t

ivision:
r Trainer

d Combat



DEPOSITORY
MAY 7 1990
UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

PB 5-90-1

Approved for public release; distribution is unlimited.

```
   DISK-B930315   REC.-610  FONT-2/215  PAGE- 383
730QH
E-0360.0000C    07200-102      CM 38-   73 M
43-11 THE * ENGINEER *

                 (NF)


43-24 20-21*1990-91*
42-28           358.205*EN*

   V.20-21*                                  ENX4
                                FOIL- WHITE
0057 BD W/O V.20:4*BIND IN SLIP*            11 1/8

                                11       6     Q-3/8
```

73'

05
v. 20
#1

ENGINEERING

102-73

Engineer

March 1990

PROFESSIONAL BULLETIN FOR ARMY ENGINEERS
quarters, Department of the Army

Roads for Jordan: Reservists in the Middle East

The 98th Division: The Engineer Trainer

ACE- The Armored Combat Earthmover

DEPOSITORY
MAY 7 1990
UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

PB 5-90-1

Approved for public release; distribution is unlimited.

Combat Engineering-

Is the Focus Too Narrow?

Since the advent of AirLand Battle doctrine, the Corps of Engineers has focused its developmental efforts to support close operations of the Army's principal warfighting doctrine in the five product areas of doctrine, force structure, equipment, training, and leader development. Initiatives such as FM 5-100 and FM 90-13-1, L-series TOEs and E-Force, the ACE and MICLIC, Engineer Battle Drills, and the Sapper Leader Course are designed to increase the combat effectiveness of our fighting force. Our total "battle focus" is on combat engineering and the sustainment of combat forces in a high-intensity AirLand Battle theater of operations. As a branch and a school, we are consumed by the execution and sustainment of AirLand Battle. More importantly, we use AirLand Battle to sustain our existence and justify the majority of our new programs.

> **"...the AirLand Battle we have postured ourselves to support has changed."**

America's success in deterring war on the European continent and overt aggression elsewhere is testimony that the Army's efforts were well founded in translating AirLand Battle doctrine into action. But, has the engineers' almost total fascination with the heavy force fight at the foreward line of own troops (FLOT) been too expensive considering our many responsibilities across the operational continuum? In concentrating so heavily on the high-intensity, low-probability end of the continuum, have we postured ourselves incorrectly? Will engineer units be properly organized and equipped to successfully respond to the likely situations faced by our nation and its military?

Emerging world situations appear to have diminished the likelihood of a high-intensity, force-on-force conflict. The Army's AirLand Battle-Future concept represents an evolution of the current AirLand Battle doctrine. This new concept brings to the forefront the past and current Army mission areas of peacetime operations and conflicts less than war. Developments in the five product areas noted earlier have been energized across the Army to address responsibilities, requirements, and solutions in the "short of war" arena.

Return to the question that titles this article. It should be obvious that the AirLand Battle we have postured ourselves to support has changed. The majority of our developmental programs probably will not support future Army force structure and missions. It appears that our combat engineering focus is too narrow. Should this surprise us? No!

History should have alerted us to the fact that combat engineering and sustainment of combat forces were only two of the missions that the Corps of Engineers has successfully executed over the past 200-plus years. If history did not serve as the alert mechanism, current nation-building operations in Latin America and elsewhere should have.

This is not to say that our concern with AirLand Battle doctrine was misplaced. I assert, however, that our neglect of the other mission areas not directly contributing to success on the AirLand Battlefield was probably a miscalculation.

(Continued on page 12)

By Lieutenant Colonel Gordon S. Quesenberry, Jr.

Engineer

March 1990 **Volume 20 PB 5-90-1**

UNITED STATES ARMY ENGINEER CENTER AND FORT LEONARD WOOD

COMMANDER/COMMANDANT
Major General Daniel R. Schroeder

MANAGING EDITOR
Catherine Eubanks
FEATURES EDITOR
Phillip R. Howell, Jr.
DESIGNER
Jennifer C. Bolyard

By Order of the Secretary of the Army:

CARL E. VUONO

FEATURES

4 **Roads for Jordan: Reservists in the Middle East**
by Lieutenant Colonel William K. Wedge and Lieutenant Colonel Wayne F. Kraft

8 **The 98th Division: The Engineer Trainer**
by Lieutenant Colonel Laurence W. Feasel

11 **The Engineer Center's AGR Link**
by Lieutenant Colonel Charles A. Doll

13 **The Engineer Bridge Battalion**
by Lieutenant Colonel Paul G. Munch

20 **ACE—The Armored Combat Earthmover**
by Lieutenant Colonel Robert J. Sperberg and Captain Craig S. Pickett

24 **Moving Mountains: Army Engineers in Bolivia**
by Specialist Bob Blocher and Captain Louis Herrera

DEPOSITORY
MAY 7 1990
UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

DEPARTMENTS

Inside Front Cover: **Personal Viewpoint**

29 **Lessons Learned**
32 **Engineer Update**
36 **Past in Review**

This volume is bound without Vol. 20 no. 4

which is/are unavailable.

nt Richard Creed, PAO, Panama

ny or TRADOC positions, nor does the content change or super-
in other official Army publications. ENGINEER reserves the right

not copyrighted. Material may be reprinted if credit is given to
he author.

STRIBUTION is targeted to all engineer and engineer-related

changes should be sent to ENGINEER, at the preceding address. Telephone: (314) 563-7762, AV 676-7762.

DISCLAIMER: ENGINEER presents professional information designed to keep Army engineers informed of current and emerging developments within their areas of expertise. Views expressed are those of the author and do not necessarily

PERSONAL SUBSCRIPTIONS are available by contacting the Superintendent of Documents, ATTN: Chief, Mail List Branch, Stop SSOM, Washington, DC 20402. Address changes for personal subscriptions should also be sent to the Superintendent of Documents.

Personal Viewpoint

Combat Engineering-

Is the Focus Too Narrow?

Since the advent of AirLand Battle doctrine, the Corps of Engineers has focused its developmental efforts to support close operations of the Army's principal warfighting doctrine in the five product areas of doctrine, force structure, equipment, training, and leader development. Initiatives such as FM 5-100 and FM 90-13-1, L-series TOEs and E-Force, the ACE and MICLIC, Engineer Battle Drills, and the Sapper Leader Course are designed to increase the combat effectiveness of our fighting force. Our total "battle focus" is on combat engineering and the sustainment of combat forces in a high-intensity AirLand Battle theater of operations. As a branch and a school, we are consumed by the execution and sustainment of AirLand Battle. More importantly, we use AirLand Battle to sustain our existence and justify the majority of our new programs.

> **"...the AirLand Battle we have postured ourselves to support has changed."**

America's success in deterring war on the European continent and overt aggression elsewhere is testimony that the Army's efforts were well founded in translating AirLand Battle doctrine into action. But, has the engineers' almost total fascination with the heavy force fight at the foreward line of own troops (FLOT) been too expensive considering our many responsibilities across the operational continuum? In concentrating so heavily on the high-intensity, low-probabili [illegible] continu [illegible] selves i [illegible] units be [illegible] equippec [illegible] to the li [illegible] our natio [illegible]

Emerg [illegible] pear to [illegible] likelihoo [illegible] force-on-f [illegible] AirLand [illegible] represents [illegible] rent AirLa [illegible] new concep [illegible] the past a [illegible] sion areas [illegible] and confl [illegible]

Developments in the five product areas noted earlier have been energized across the Army to address responsibilities, requirements, and solutions in the "short of war" arena.

Return to the question that titles this article. It should be obvious that the AirLand Battle we have postured ourselves to support has changed. The majority of our developmental programs probably will not support future Army force structure and missions. It appears that our combat engineering focus is too narrow. Should this surprise us? No!

History should have alerted us to the fact that [illegible]

[illegible] on page 12)

By Lieutenant Colonel Gordon S. Quesenberry, Jr.

Engineer

March 1990

Volume 20 PB 5-90-1

UNITED STATES ARMY
ENGINEER CENTER AND
FORT LEONARD WOOD

COMMANDER/COMMANDANT
Major General Daniel R. Schroeder

MANAGING EDITOR
Catherine Eubanks
FEATURES EDITOR
Phillip R. Howell, Jr.
DESIGNER
Jennifer C. Bolyard

By Order of the Secretary of the Army:

CARL E. VUONO
General, United States Army
Chief of Staff

Official:

WILLIAM J. MEEHAN II
Brigadier General, United States Army

FEATURES

4 **Roads for Jordan: Reservists in the Middle East**
by Lieutenant Colonel William K. Wedge and Lieutenant Colonel Wayne F. Kraft

8 **The 98th Division: The Engineer Trainer**
by Lieutenant Colonel Laurence W. Feasel

11 **The Engineer Center's AGR Link**
by Lieutenant Colonel Charles A. Doll

13 **The Engineer Bridge Battalion**
by Lieutenant Colonel Paul G. Munch

20 **ACE—The Armored Combat Earthmover**
by Lieutenant Colonel Robert J. Sperberg and Captain Craig S. Pickett

24 **Moving Mountains: Army Engineers in Bolivia**
by Specialist Bob Blocher and Captain Louis Herrera

DEPARTMENTS

Inside Front Cover: **Personal Viewpoint**

2 **Clear the Way**
3 **Bridge the Gap**
19 **Engineer Problem**
27 **Engineer Solution**
29 **Lessons Learned**
32 **Engineer Update**
36 **Past in Review**

DEPOSITORY
MAY 7 1990
UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

Cover photos by Sergeant Richard Creed, PAO, Panama

ENGINEER (ISSN 0046-19890) is prepared quarterly by the U.S. Army Engineer School, ATTN: ATSE-TDM-PB, Fort Leonard Wood, MO 65473-6650. Second Class postage is paid at Fort Leonard Wood, MO, and additional mailing offices.

POSTMASTER; Send address changes to ENGINEER, the Professional Bul-etin for Army Engineers, ATTN: ATSE-TDM-PB, Fort Leonard Wood, MO 65473-6650.

CORRESPONDENCE, letters to the editor, manuscripts, photographs, official nit requests to receive copies, and unit address changes should be sent to ENGINEER, at the preceding address. Telephone: (314) 563-7762, AV 676-7762.

DISCLAIMER: ENGINEER presents professional information designed to keep Army engineers informed of current and emerging developments within their areas of expertise. Views expressed are those of the author and do not necessarily reflect official Army or TRADOC positions, nor does the content change or supersede information in other official Army publications. ENGINEER reserves the right to edit material.

CONTENT is not copyrighted. Material may be reprinted if credit is given to ENGINEER and the author.

OFFICIAL DISTRIBUTION is targeted to all engineer and engineer-related units.

PERSONAL SUBSCRIPTIONS are available by contacting the Superintendent of Documents, ATTN: Chief, Mail List Branch, Stop SSOM, Washington, DC 20402. Address changes for personal subscriptions should also be sent to the Superintendent of Documents.

CLEAR THE WAY

By Major General Daniel R. Schroeder, Commandant, U.S. Army Engineer School

In the last year, the world has witnessed sweeping political and social changes. From the Soviet Union, Eurasia, Middle East, and the People's Republic of China to Central and Latin America, and Africa, the world as we knew it a year ago no longer exists. Between Labor Day and Christmas, six governments in Eastern Europe were changed. Last year's possible adversaries now appear as possible friends, and allies are now discussing unprecedented topics. All indications are that these winds of change will continue and will affect every facet of western civilization and the world balance of power.

The United States has responded to the lessening of world tension by electing to reduce military forces, and the Army will shoulder its share of these reductions. Although we do not yet know the full magnitude of the proposed structure changes, it is safe to say that our future posture may well include an increase in the role of Reserve Components (RC).

No matter what you may read about possible structure changes, you need to know that the evolution of the Army toward the 21st century will be carefully managed by the Army leadership. The Secretary of the Army and the Chief of Staff of the Army are in charge, and they will ensure that the Army is shaped to meet the nation's strategic requirements. Our challenge is to make sure the total engineer force is trained and ready and that it remains a versatile and deployable force—and a lethal one when needed!

The nation has always relied on Reserve Components to meet its mobilization needs. More than one-half million RC soldiers served in both World Wars I and II, respectively. In Korea, they contributed more than 400,000 soldiers; 300,000 soldiers in the Berlin Crisis; and more than 150,000 soldiers in Vietnam. Recently, they were involved in the Grenada operation, especially in rebuilding the country's infrastructure, and they are involved in Panama today along the same lines.

We anticipate there will be a smaller Active Component (AC) engineer force and, therefore, increased reliance on the RC engineer force. These engineers are essential to the total force because they make up approximately 66 percent of the Corps of Engineers. Of approximately 100,000 total engineers (officers and enlisted), 38,000 are members of the National Guard and 28,000 are members of the Army Reserve. By units, 71 percent of engineer bridge companies, 64 percent of engineer battalions, and 82 percent of engineer groups and brigades exist in the RC.

In recent times the Corps has again demonstrated its leadership in nation building, and RC engineers have had a major role. Since 1984, more than 27,500 RC engineers have been deployed in SOUTHCOM, predominantly to Honduras, Panama, and Ecuador. This nation-building capability is an integral part of our nation's response to peacetime engagements in low intensity conflicts. The presence of engineers in a nation-building role is nonprovocative, builds an infrastructure for a sound economy not based on drug production, and enhances the survival of fledgling democracies. Given the successful history of the Corps in nation building both at home and abroad, this mission will remain with us in the future. It has great potential for becoming more important to our national strategy.

The history of our nation's military is a cyclic one of mobilization to meet a threat followed by a period of demobilization. These past periods of demobilization have historically not treated the RC well and were normally periods of decline in readiness for them.

Today our RC units are interwoven into the fabric with the AC. When elements of the Army deploy on a mission, they take their RC CAPSTONE Trace with them. As decisions are made concerning the AC's force structure, we must redouble our efforts to provide the best training available to maximize limited RC training time. We must execute better planning to reduce RC unit redesignation turbulence, and introduce new distributed training technology to reduce the effects of RC dispersion.

As a branch, we must re-evaluate our force and unit structures, doctrine, missions, and training for both Active and Reserve Component engineers. The Engineer Center has a keen interest in engineer RC issues—call if we can be of assistance.

We invite the RC engineer force to visit their Engineer Center and participate as we re-examine our doctrine, force structure, mission, and training for the 21st century. Remember, our obligation is to provide the Army—and the nation—with a total engineer force that is trained and ready!

BRIDGE THE GAP

By Command Sergeant Major Acle R. Gardner (Retired),
U.S. Army Engineer School

It seems like it was only yesterday when I first raised my hand to take the oath to enter the Army, but it has been almost 30 years. A lot of changes have occurred during that time.

In this, my last article for the *ENGINEER Professional Bulletin* before retirement (December 1989), I want to discuss some of those changes.

The first topic is physical fitness training. Physical training (PT) is better, tougher, and more effective now than when I first entered the service. We had soldiers and leaders who could not meet the standards then, and we have soldiers and leaders who cannot meet today's standards now. While there may be several reasons for this, I think the root of the problem is that training to standard does not happen at all formations.

Tomorrow morning, look at any company PT formation. You probably will see several noncommissioned officers in the rear of the formation and, more likely than not, they will not be making corrections of soldiers who perform the exercises incorrectly. In fact, they may not perform the exercises to standard either. The number of days PT is given each week also has a bearing on this. PT on Mondays, Wednesdays, and Fridays may be adequate for sustainment purposes, but I doubt if soldiers will realize any improvement.

Another problem is the testing standard. Too many units have the tested soldiers pair off and grade each other. This method of grading can produce a low failure rate.

The reason I think this happens is that many soldiers who arrive at our schools (NCOES) do not pass the diagnostic PT test we give them. The failure rate for some classes has been as high as 50 percent, even though the soldiers brought PT cards with them indicating passing scores within the past 6 months. I believe we can do better than this by knowing what the standards are and enforcing them.

Another topic near and dear to my heart is land navigation/map reading. This subject is a requirement for passing the Primary Leadership Development Course (PLDC) and the Basic Noncommissioned Officers Course (BNCOC), and it contributes to more failures than any other single subject. Back in the 1960s and 1970s, before common task training, 12 hours of map reading were mandatory each year. At that time soldiers did not seem to have the difficulty with this subject they are having now.

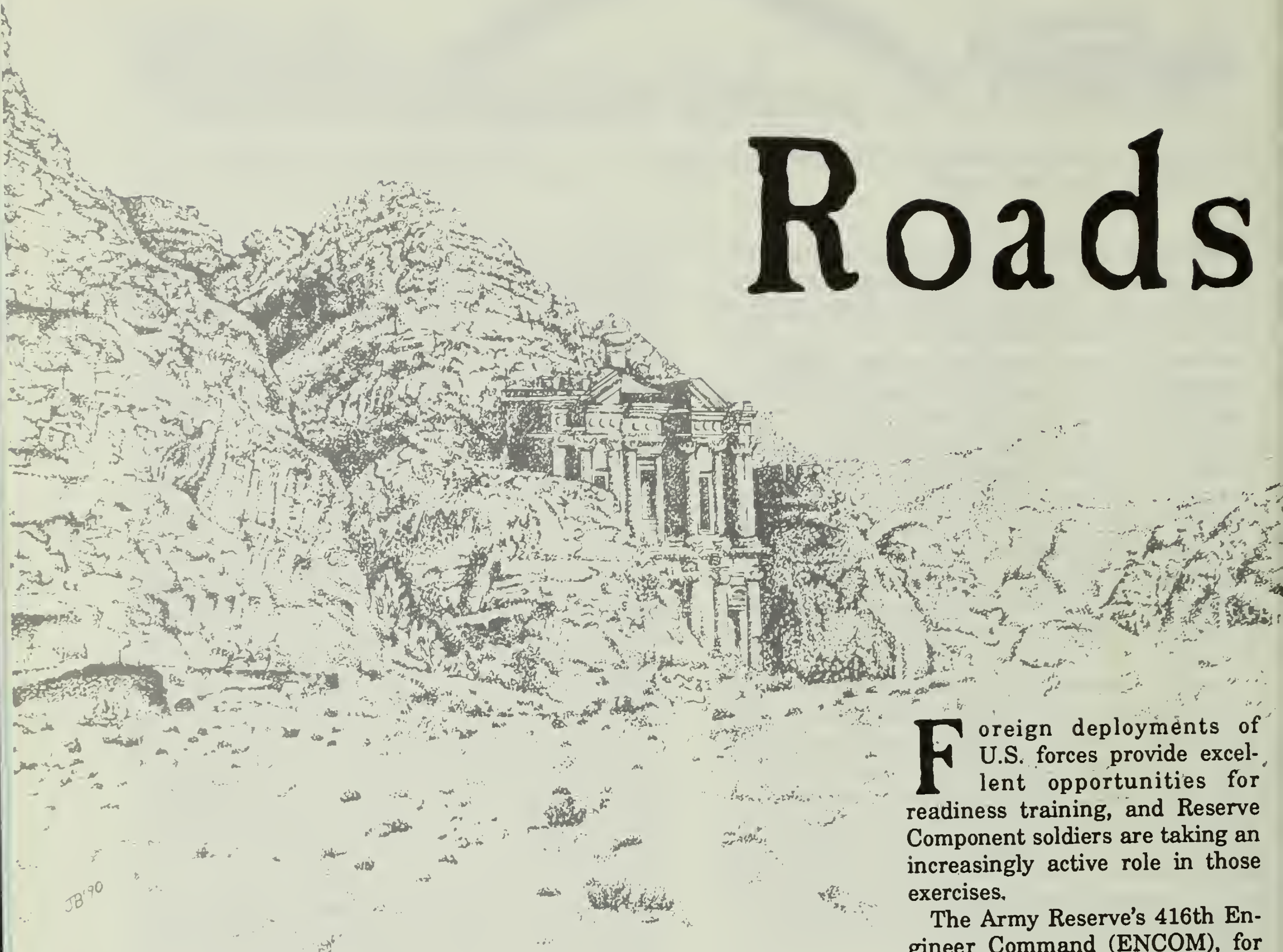
We had to release seven soldiers from PLDC recently for failing land navigation. When these soldiers were asked how much training they had received in their unit, a few of them said they had 10 hours or less. The rest said they had not received any training since basic training. That is a shame, because those soldiers cannot be promoted until they pass PLDC. Every soldier must have the basics down before he or she arrives at the school.

I think training your soldiers is just as important as making sure they are fed—it's another part of taking care of them. Generally speaking, the combat arms folks don't seem to have as much problem in this area as we do.

The last topic that I want to mention is our overweight soldiers. These people keep moving around the Army from one place to another, and they report into schools in an overweight status. When this happens, it reflects directly back to the soldier's losing chain-of-command, including the NCO support chain. If you receive an overweight soldier, write a letter to his or her losing battalion command sergeant major or to the commander. Let them know that at least you know they are not doing their job.

With that off my chest, I must tell you that I have really enjoyed my 30 years. If I had it to do over again, I would do the same thing. I want to thank all of the NCOs and officers who helped, guided, and mentored me through my career, and especially those soldiers who have worked for me over the years. I attribute all my success to you.

Roads



By Lieutenant Colonel William K. Wedge and
Lieutenant Colonel Wayne F. Kraft

Foreign deployments of U.S. forces provide excellent opportunities for readiness training, and Reserve Component soldiers are taking an increasingly active role in those exercises.

The Army Reserve's 416th Engineer Command (ENCOM), for instance, recently completed construction of three roads in the northern highlands of Jordan. The project, a joint operation conducted with the Jordanian Armed Forces (JAF), combined the efforts of Reserve, National Guard, and Active forces.

The 416th ENCOM, headquartered in Chicago, is a theater level command with the primary mission of supporting the Third U.S. Army (TUSA). The command has gained extensive experience in the Middle East region during the last four years, and has responsibility for construction projects in Northeast Africa, the Arabian Peninsula, and Southwest Asia.

For Jordan:

Reservists in the Middle East

The roads project in Jordan consisted of completing one road started in 1987 and building two new roads. Construction plans called for 13.7 kilometers (km) of roadway and 17 reinforced concrete pipe culverts with concrete headwalls and wingwalls.

The 416th had overall responsibility for the project in support of TUSA's Southwest Asia engineer mission. Actual construction was accomplished by Reserve and National Guard units during six two-week annual training periods in 1988 and 1989, and by an Active Component unit. Construction soldiers for the project were provided by the 265th Engineer Group and the 878th Engineer Combat Battalion (Heavy), both of the Georgia National Guard; the 348th Engineer Group and the 926th Engineer Combat Battalion (Heavy), both USAR units from Alabama, and the 92nd Engineer Combat Battalion (Heavy), an Active Component unit from Fort Stewart, Georgia.

The Jordan project provided ENCOM and the participating units with valuable opportunities for training in construction and project-management techniques, engineer road construction methods, and unit preparation for overseas movement.

Site Survey

Preparation for the project began in January 1988 with a geologic site investigation as the main basis for the pre-deployment site survey (PDSS). The PDSS revealed that earlier work on the existing road had washed out during heavy winter rains, and that soil conditions would give the engineers their biggest challenge. A viable method of stabilizing erosion of the roadbed soil was needed.

Preliminary analysis of soil sampled along the existing road showed it to be a silty or lean clay (classified CL by the Unified Soil Classification System, or USCS). This type of soil presented two significant engineering problems: low compressibility when dry, and high volume changes between wet and dry conditions. The clay was discovered to undergo considerable softening during the rainy season. It then becomes a fine dust, susceptible to deep rutting and subsequent severe dust problems during the dry summer months.

The existing road had been constructed in a valley. Alluvial material, derived from the limestone, marl, and chert bedrock which made up the low rolling hills in the area, was used as fill.

Soil Analysis

After the initial geologic site investigation, a local engineering contractor was selected to assist in additional soil analyses. While the need for soil stabilization was evident, further testing was needed to determine which stabilization method best suited project requirements. The Arab Center for Engineering Studies (ACES) was contracted to do 15 exploratory pits and to analyze soil samples for moisture content, grain size, modified Proctor characteristics, California Bearing Ratio (CBR), and Atterburg Limits (Liquid Limit, Plastic Limit, and Plasticity Index). The effects of both lime and cement treatments were evaluated.

ACES determined that the available soil along the route was a clayey-silt to silty-clay-with-sand (A-6 Group soil by the American Association of State Highway and Transportation Officials [AASHTO] classification). Hydrometer analyses for the (-) 200 size fraction showed the representative indigenous soil mixture obtained from the test pits to be 17 percent sand, 36.8 percent silt, and 19.7 percent clay. Atterburg Limits for the soil mixture were:

Liquid Limit: *38.8 percent*
Plastic Limit: *22.3 percent*
Plasticity Index: *16.5 percent*

Natural moisture content of the samples ranged from 7.5 percent to 12.5 percent. The average bearing ratio of the laboratory-compacted soil (CBR) was 15.1 percent at 0.1 inch penetration and 18.3 percent at 0.2 inch penetration.

Soil Stabilization

A-6 soil is generally considered to represent only a "poor" subgrade material. Therefore, it was initially believed that the best procedure to improve road stability would be to remove fill material down to bedrock or to change the road alignment to take advantage of machine-workable limestone bedrock. Another option was to add various quantities of cement and/or lime for stabilization. The final choice of admixture to be used would be determined by economics and availability of materials. Four options were considered:

(1) Stabilize the soil with about 10 percent cement to a depth of about 20 centimeters (cm) (8 inches), and cover with crushed rock and an asphaltic seal coat.

(2) Stabilize the soil with 3 to 4 percent lime and adequate compaction, and cover with crushed rock and an asphaltic seal coat.

(3) Stabilize the soil with a combination of about 4 percent lime and 6 percent cement. Combining the lime and cement would reduce plasticity, increase workability, reduce swell, and generally increase the ultimate strength. Lime pretreatment would be followed by an admixture of cement.

(4) Stabilize the soil mechanically by compacting the subgrade with adequate water (about 10 gallons per square meter), and cover with crushed rock and an asphaltic seal coat.

Of the four choices, mechanical stabilization by compaction is the least expensive, and was the method ultimately selected. After costs were estimated for each method, the first three options were ruled out as cost prohibitive, based on available funding.

Reservists from Alabama's 926th Engineer Combat Battalion (Heavy) use a scoop loader to install culvert. The unit constructed 4 km of roadway during May and July of 1989 (Photo by CPT Doug Bixler).

Jordanian engineers from the Arab Center for Engineering Studies (ACES) take soil samples along a proposed roadway. The ACES soil analyses were contracted by the U.S. Army to help determine the best method of road construction in the very dry Jordanian terrain (Photo by LTC Wedge).

Construction

The road design for the project, with some minor modifications, was taken from TM 5-330, *Roads, Airbases, and Heliports in the Theater of Operations*. Because of the amount of rocky material encountered just below the surface, excavation in the cut areas was minimized so that road alignment followed the natural contour of the land wherever possible. This also minimized the amount of fill material needed to bridge wadis (gullies), thereby confining the major construction problem to that of soil stabilization.

The problem of supplying enough water to achieve the necessary compaction was solved by contracting two local commercial water distributors. To achieve the desired results, the soil had to be brought to optimum moisture content, wind-rowed, mixed, re-spread with a motor grader, and then compacted with a smooth steel-drum roller.

From September to November of 1988, the 92nd Engineer Combat Battalion (Heavy), the 265th Engineer Group, and the 878th Engineer Combat Battalion (Heavy) upgraded 9.7 km of existing roadway. The units reshaped and compacted existing subgrade, installed two 5-inch layers of compacted base course and a wearing surface of medium cure (MC-) 70, rapid cure (RC-) 800 bitumen, and one-quarter inch pea gravel. Five 90-cm RCP culverts with ten concrete headwalls and wingwalls were installed to accommodate the flash floods characteristic of the arid region.

The 926th Engineer Combat Battalion (Heavy) deployed during May and July 1989 and constructed 4 km of roadway. This was a complete project from beginning to end, and included survey and design, initial excavation, borrow work, filling, hauling, shaping, and compacting the subgrade. The previous year's base course and wearing surface design was used again. Eleven RCP culverts ranging from 50 cm to 120 cm, single to triple barrel, were installed. The largest was a double 120 cm, 20 meter (m) long culvert.

In addition to the challenging engineering aspects of the Jordan project, preparation of participating units for movement to the Middle East provided commanders and staffs at all levels with valuable experience in overseas deployment and operations. ENCOM, group and battalion staffs worked closely together to determine requirements for personnel, equipment, material and other support necessary for success of the project.

The project proved to be a highly successful demonstration of the "One Army" concept, meshing the capabilities and talents of Reserve, National Guard, and Active forces. Tough, demanding deployment and construction operations in this critical region of the world not only provided the Jordanians with new roads, but provided U.S. soldiers with first-class training.

Lieutenant Colonel Wedge, a USAR officer and staff engineer with Headquarters, 416th Engineer Command, has conducted many geotechnical evaluations for construction projects in Southwest Asia and Korea. He commanded the 471st Engineer Company (Construction Support) from 1977 to 1981. He holds a doctorate in geology from the University of Missouri at Rolla, and is a graduate of the Command and General Staff College.

Lieutenant Colonel Kraft is a USAR officer and serves with the Engineering Section of the 416th Engineer Command. Previous assignments include project officer for Blazing Trails 87 and Fuertes Caminos 88 in Honduras, and the roads project in Jordan. He also served as assistant engineer team leader, 85th Division Maneuver Training Command, and was a company commander in the 3rd Brigade, 85th Division (Training) from 1976 to 1979. He is a graduate of the Command and General Staff College.

The 98th Division:

The Engineer Trainer

By Lieutenant Colonel Laurence W. Feasel

The wartime mobilization of Reserve and National Guard forces would place heavy demands on the Army's ability to quickly train the manpower needed to support fighting units. With engineers playing an increasingly critical role on today's modern battlefield, field commanders must be provided with adequate numbers of those soldiers to support operations throughout the spectrum of conflict. And ensuring that each engineer is tactically and technically proficient is just as important as the sheer number of soldiers.

To make sure a mobilized Army gets the quality engineer manpower that it needs, the Army Reserve's 98th Division (Training), headquartered in Rochester, New York, is assigned the mission of supporting the Engineer Center and School in meeting the requirements of the Mobilization Army Program for Individual Training (MOBARPRINT). The training division, a type of unit which exists only in the Army Reserve, has the responsibility of providing drill sergeants and instructors, as well as a supporting structure, for the Engineer Center.

Until 1959, the United States Army Reserve (USAR) was assigned maneuver divisions. In that year, all combat divisions, less a few separate brigades, were concentrated in the Army National Guard. As a result, 12 USAR divisions were restructured as training divisions with the mission of augmenting existing Army training centers or opening new ones. Other USAR divisions became numbered Army Reserve Commands (ARCOMS), with peacetime responsibility for command and control of units undergoing mobilization.

Initially, the 98th Division consisted of the 389th, 390th and 391st Basic Training Regiments, and the 392nd Advanced Individual Training Regiment. In 1967, the 392nd, now designated the 3rd Brigade, was assigned responsibility for 12B instruction. It became the first major subordinate command of the division to have annual training and mobilization missions at Fort Leonard Wood. The remainder of the division was still committed to east coast mobilization stations.

In 1977, the division was reorganized to better meet the mobilization needs of Fort Leonard Wood. Studies of the lethality rates in the Arab-Israeli wars by the Training and Doctrine Command resulted in an Army decision to increase the number of soldiers undergoing 12B training. Accordingly, the division's 1st and 2nd Brigades joined the 3rd Brigade in a 12B/C and one-station unit training (OSUT) mission.

The 98th was also given the responsibility of augmenting Fort Leonard Wood during mobilization. The division's 4th Brigade (CST) [common skills training] continued its mobilization mission of teaching a variety of combat service support specialties in other locations.

The division's relationship with the Engineer Center and School was expanded to a full partnership in 1987 and 1988, when the 4th Brigade was designated for conversion to a basic training mission. With its full range of mobilization affiliations, the 98th could now have a comprehensive dialogue on training issues with Fort Leonard Wood.

On mobilization, the 98th augments engineer training at all levels. An initial division deployment to Fort Leonard Wood during the first three weeks of mobilization supports initial demand for soldier basic training.

The division's full mobilization can be accomplished within 15 weeks, with the rate of mobilization dependent on the Army's training needs. The division's 1st, 2nd, and 3rd Brigades support Fort Leonard Wood's 132nd Brigade and its three battalions in training 12B and 12C military occupational specialties (MOS). The 98th's 4th Brigade, with four basic training (BT) battalions, works with the Engineer Center's 3rd Training Brigade and five BT battalions of the 10th Infantry to focus on fundamental soldier skills.

The division's Training Group brings a variety of career management field (CMF) instructors to Fort Leonard Wood's lst and 136th Engineer Brigades, including the 12B, 12C, 12F, 51, 62, 63, and 88 fields. The 98th's Leadership Academy augments the Engineer Center's NCO Academy. The division also brings the staffs of three U.S. Army Reserve Forces Schools to reinforce Fort Leonard Wood's instructor capability. At full strength, the 98th brings 944 drill sergeants and 706 other instructors to fill engineer training requirements during mobilization.

To maintain readiness for this mobilization mission, the division conducts displacement exercises every year from April through September. Under this Unit Displacement Program, the 98th's battalions and companies assume full responsibility for the command, control, and training of new soldiers during specific periods of the training cycle. In an average year, up to 1,000 new soldiers

A drill sergeant from the 98th Division counsels a basic trainee at Fort Leonard Wood for having a dirty weapon. Every year, about 1,000 new engineers benefit from the expertise of the 98th Division (U.S. Army photo).

A soldier from the 98th Division practices the placement of a Claymore mine as part of a "train-up" program sponsored by active duty units. The program is designed to assist 98th Division drill sergeants and other selected NCOs in maintaining engineer skills while serving in non-TOE units (U.S. Army photo).

benefit from training provided by the 98th Division, with some 1,200 to 1,400 division personnel deploying to Fort Leonard Wood in this successful partnership effort.

The close cooperation between the 98th and Fort Leonard Wood has also led to an innovative solution to an old problem. One of the biggest challenges facing the division is the dual development of its noncommissioned officers as both drill sergeants and engineer leaders. Talented soldiers demonstrating a high potential for drill sergeant duty are recruited and trained by the division's Leadership Academy. They then remain "on the trail" with drill sergeant duties for an average of eight to ten years.

Unfortunately, many NCOs don't get the opportunity to serve as squad leaders or platoon sergeants in TOE organizations during this period of drill sergeant duty. This cripples their professional development because it precludes them from becoming fully qualified in an engineer career management field.

Over the past year, two Active Component corps combat battalions—the 5th at Fort Leonard Wood and the 39th at Fort Devens—have sponsored a combat engineer leader "train-up" program for the 98th Division. A recent phase of the program took place at Deep Woods, Maine, under the direction of the 39th. A group of division NCOs were given the opportunity to use demolitions to destroy several old bridges and use tactical bridging techniques to replace the spans. The program, which also assists in the training of other noncommissioned officers in three of the division's OSUT battalions, has been highly successful in upgrading the technical competence of participants.

The number of active duty soldiers trained by the division is expected to increase steadily in the coming years, further strengthening the partnership between the 98th and Fort Leonard Wood. And it is a partnership that benefits the entire Army engineer community.

Lieutenant Colonel Feasel is an Army Reserve Officer currently serving as assistant chief of staff, G-3, for the 98th Division (Training). He previously served as battalion commander of the 2nd Battalion, 391st Regiment (EN OSUT). His active duty service includes a tour with the 4th Infantry Division in Vietnam. He is a graduate of the Engineer Officer Advanced Course, Command and General Staff Course, and the National Defense Management Course. He is currently completing Army War College and holds a masters in history from the University of Rochester.

The Engineer Center's AGR Link

By Lieutenant Colonel Charles A. Doll

National Guard and Reserve soldiers make up 70 percent of the Army's engineer forces. Teamed with the active Army, they play a full partnership role in the military readiness of the nation.

In recognition of the importance of total Army teamwork, the Engineer Center has a staff of active Guard and Reserve (AGR) personnel to facilitate cooperation between the components. These officers and NCOs are experienced and accomplished members of the Reserve Components, and actively participate in planning and implementing Army operations.

One of their primary jobs is assisting the active force in developing and managing the training of Army Guard and Reserve soldiers. From basic training to senior officer instruction, the AGR staff provides the Engineer School with a vital link to understanding the special training needs of the Reserve Components. In addition to playing a central role in the formulation and implementation of training programs, AGR personnel also serve as advisors to unit commanders, directors, and both officer and enlisted students attending training at Fort Leonard Wood.

A brief description of each of the AGR positions at the Engineer Center, with telephone numbers and office symbols, is provided for both Active and Reserve Component personnel who may need assistance.

ARNG/USAR Advisors

These officers are the senior Reserve Component representatives at the Engineer Center and participate in decision meetings on training, force structure, weapons systems, distributive education, doctrine, plans and policies. They provide instruction on the Reserve Components to the Engineer Officer Basic and Advanced Courses and the Pre-Command Course. These advisors are also charged with overseeing the welfare of Reserve Component officer students, and providing them with academic and career counseling. Other duties include participation in CAPSTONE conferences, serving on the Engineer Center's executive council, and monitoring all AGR personnel working at the Engineer Center. The USAR senior advisor is COL Shoff, Autovon 676-6336/ATSE-DAC-AR. The ARNG senior advisor is LTC Doll, Autovon 676-7742/ATSE-DAC-NG.

Directorate of Reserve Components

These officers are responsible for planning and coordinating all Reserve Component annual and weekend training. They advise the Engineer Center's chief evaluator on Reserve Component training matters and coordinate mobile training team support for Fort Leonard Wood and off-post requirements. These advisors also counsel and provide assistance to all Reserve Component personnel attending special training at the Engineer Center. The director is COL Vienneau (USAR), Autovon 581-3181/ATZT-RC. The deputy director (ARNG) is MAJ Sletten, Autovon 581-8816/ATZT-RC-NG.

ARNG/USAR Liaison NCOs

These senior NCOs serve as advisors to all Reserve Component soldiers attending basic and advanced individual training at Fort Leonard Wood. They also assist Reserve NCOs attending courses at the post. They provide motivational counseling, assist units in solving personnel problems, and ensure the smooth transition of soldiers through the training cycle. These NCOs provide a link between the soldiers and their home state units. The USAR liaison NCO, SGM Harris, is at Autovon 581-2186; his office symbol is ATZT-RC-RL. The ARNG liaison NCO is SGM Woide, (314) 596-2186/ATZT-RC-NGL.

ARNG/USAR Training Development Officers

These officers work in the Reserve Training Office, Directorate of Training and Doctrine. They oversee the course configuration program, providing exportable, institutional-quality training materials for engineers at Reserve Component schools. They also provide input on skill qualification tests (SQTs), graphic training aids (GTAs), Army correspondence course programs (ACCPs), programs of instruction, and new equipment system training. The ARNG training development officer is LTC Doll, (314) 563-7742/ATSE-TDR-T. The USAR training development officer is MAJ Davison, (314) 563-7522/ ATSE-TDR-T.

ARNG Force Integration Officer

This officer, attached to the Directorate of Combat Developments, works on force structure design, basis-of-issue plans, new military occupational specialties (MOS) to support new equipment systems, Division Engineer (DIVENG), and stationing plans. The ARNG force integration officer is MAJ Graves, Autovon 676-2381/ATSE-CDO-F.

USAR Mobilization Officer

This officer works for the Director of Plans, Training and Mobilization. He plans and coordinates mobilization missions at Fort Leonard Wood and works with facility utilization planning. The USAR mobilization officer is MAJ Hailey, Autovon 581-2145/ ATZT-PTM-MP.

Any organization or individual with questions on engineer Reserve Component matters is encouraged to contact the appropriate AGR office.

Lieutenant Colonel Doll is the Army National Guard senior advisor and the military deputy for the Directorate of Training and Doctrine, U.S. Army Engineer School, Fort Leonard Wood.

(Personal Viewpoint continued)

The following examples support my miscalculation assertion:

- Engineer units organized for construction missions cannot readily be strategically deployed.
- Developmental efforts in hand-emplaced, antipersonal land mines have given way to FASCAM efforts. However, hand-emplaced mines will be needed in light and special operations force actions.
- Countermine developmental efforts have focused on the mechanized task force breach of complex obstacles. Yet light forces require man-transportable countermine capabilities.
- Military dynamite was removed from the Army's inventory without replacement. Thus, construction and quarry blasting require procurement of local, commercial explosives.

True, the AirLand Battle-Future concept will broaden our focus and developmental efforts. Also true, resource reductions will make it more difficult to execute needed efforts in the five product areas. Let us reconsider our objectives so that we can bring to fruition those combat engineering efforts that serve the Army across the entire operational continuum.

Lieutenant Colonel Quesenberry is assigned as a military planning officer in the Military Engineering and Topography Division, Office of the Chief of Engineers. He was previously assigned as assistant director, Department of Military Engineering, U.S. Army Engineer School, Fort Belvoir.

The Engineer Bridge Battalion

By Lieutenant Colonel
Paul G. Munch

As Divisional Engineer (DIVENG)—formerly known as E-Force—concepts and organizations are fine tuned, more attention is being focused on the engineer organizations located at the corps level. In particular, the assault float bridge battalion of the heavy corps' engineer brigade is a unique and formidable unit that deserves a closer look. While bridge battalions have existed in the past, only one—the 565th—remains on active duty.

The engineer bridge battalion (Figure 1, p. 14), with 60 percent of a three-division corps' float bridge assets and all of the tactical fixed bridge and supplementary bridge assets, possesses immense capabilities. It can provide almost 640 meters of organic ribbon bridge, 122 meters of medium girder bridge (MGB), and has the potential for substantial supplementary float and tactical fixed bridging from its bridge park.

Perhaps more important, the battalion headquarters provides command and control over bridging operations, which potentially could be conducted over the corps' entire area of operations.

This capability does not currently exist at the battalion level. It is normally relegated to the control of a group or brigade headquarters which is usually preoccupied with managing the combat engineer assets in the forward areas.

The battalion's headquarters also provides float and fixed bridging expertise to both engineer and maneuver commanders. While all engineer officers are knowledgeable in river and tactical dry span crossing techniques, there is no substitute for day-to-day experience with bridging operations. Detailed expertise is essential during the planning and execution phases of complex river crossing operations. This headquarters can normally be expected to provide expert officers to act as staff engineers at the crossing force and crossing area headquarters during a deliberate river-crossing operation.

The Evaluation

The 565th Engineer Battalion was in a unique position to evaluate the potential of the DIVENG concept during the 1988 corps-against-corps Reforger exercise, Certain Challenge. Assigned to the 7th Engineer Brigade in Germany, it consists of a headquarters and headquarters detachment, the 93rd and 502nd Engineer Companies (assault float bridge), and 8594th German Civilian Service Group (assault float bridge). In addition, E Company, 1st Engineer Battalion, was attached to the battalion throughout the exercise. The 38th Engineer Company (MGB) was assigned to the battalion during the second week of the exercise (Figure 2, p. 15).

The 565th Headquarters and Headquarters Detachment (HHD) has the dual mission of commanding and controlling three to five companies and providing bridging expertise to other engineer and maneuver headquarters. Under the DIVENG concept, it would also be capable of organizing and controlling a corps-level bridge park.

The two assault float bridge companies are standard corps-level ribbon bridge companies. Each company can construct up to 214 meters of ribbon bridges, six five-float rafts, or a variable combination of rafts and bridges. In addition, their secondary missions require they provide transportation to haul 280 tons of barrier material per lift. They also provide the transport and expertise to construct Class 60 and M4T6 float bridging to replace the ribbon bridging moving forward.

The 8594th Civilian Service Group (CSG) has missions and capabilities similar to the other ribbon bridge companies, but its members are German civilians. Upon initiation of hostilities, this unit would reorganize into a German Army unit as an assault float bridge company equipped with ribbon bridges.

In this configuration, under Wartime Host Nation Support Agreements, the 8594th CSG's capabilities would be returned to U.S. forces in a role of obligatory cooperation.

Preparation

The 565th Engineer Battalion's preparation and involvement in Reforger began early. Two months prior to the exercise, the battalion was asked to sponsor the ribbon bridge company of the 1st Engineer Battalion (1st Infantry Division), and provide a training program that would maximize the benefits of the company's 6-week deployment to Germany. Solid planning and coordination allowed the company to quickly draw their equipment, "shake-down" equipment difficulties, and

The Engineer Bridge Battalion

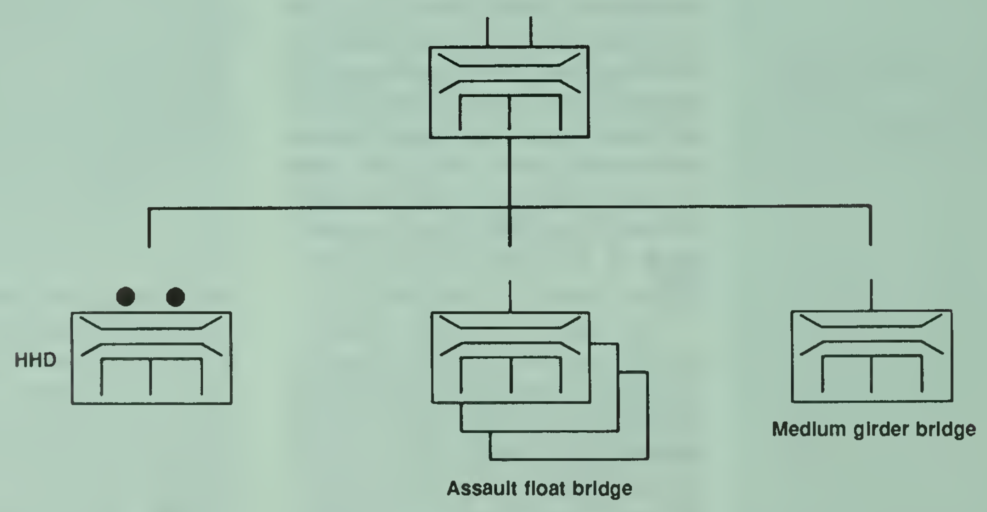


Figure 1

move ahead with their training schedule.

The training program began by developing individual skills, i.e., boat operators, raft commanders, etc. It then progressed from rafting operations, through bridging operations in still water, and finally to fast-water operations on the Danube River.

While the 565th was coordinating with engineer units in the United States, it was also providing expertise to European-based maneuver units. The battalion commander and staff worked closely with those units anticipating possible river crossing operations during Reforger. As an example, the battalion assisted the 2nd Brigade, 3rd Infantry Division, in refining a river crossing plan for the Main River. The plan included an opposed/dismounted infantry assault crossing and three assault float bridge crossing sites.

This particular plan envisioned the 565th Battalion HHD providing a small cell of experts to assist the crossing force and crossing area commanders. The remainder of the HHD would form a task force headquarters to command its own two corps-level bridge companies, two divisional ribbon bridge companies, a mechanized combat engineer company, a military police platoon, and smoke assets (Figure 3, p. 16). Task Force Remagen would report directly to the crossing area commander and essentially control all aspects of the bridging operations. Planning culminated in a "sandbox" rehearsal with the maneuver and engineer commanders just prior to the exercise.

First Week

The battalion began the exercise by deploying a headquarters element and a ribbon bridge company to support tactical operations. In addition, it established the VII Corps' bridge park to provide the corps with Bailey and M4T6 dry span bridges. These elements reported directly to the 372nd Engineer Group, an Army Reserve headquarters from Iowa.

Attachment to the 372nd Group proved valuable for both parties. The group headquarters assisted the battalion in planning future river crossing operations. In return, the battalion provided expertise on USAREUR policies, procedures and planning. The association also provided valuable interaction between reserve and active forces.

While reporting to the 372nd Group for tactical missions, the 565th Engineer Battalion also reported directly to the VII Corps Headquarters (Rear) as a base cluster supporting the defense of the corps' rear area. This dual command relationship required that the battalion staff not only continue planning for assault float bridging operations across the corps' entire front, but also plan for contingency operations in the corps' rear area. This unique opportunity showed many of the battalion's strengths and weaknesses.

Reforger—the Second Week

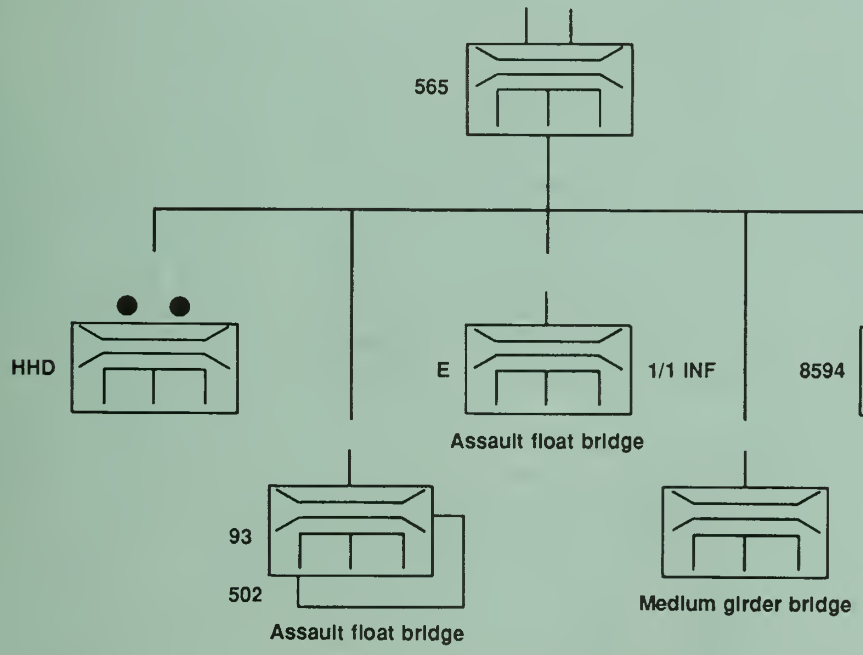


Figure 2

As the first week closed, personnel from the bridge companies participated in a corps-level command post exercise (CPX) to test the companies' ability to support the corps' barrier haul missions. Each of the companies showed that they were capable of meeting those missions.

Second Week

During the second week, the 565th Engineer Battalion reported directly to the 7th Engineer Brigade (also the corps' rear headquarters) and had the 38th Engineer Company (MGB) attached to it.

Throughout the second week, the battalion staff continued to develop plans to support maneuver units anticipating river-crossing operations. It also supported the entire corps with medium girder bridging from the 38th Engineer Company and with supplemental fixed bridging from its bridge park. While the tactical situation did not call for an assault float bridge crossing, the ribbon bridge companies were prepared to react on very short notice.

Lessons Learned

Certain Challenge proved to be an excellent opportunity to evaluate the usefulness of the bridge battalion. It provided the opportunity to validate both current and new ideas. The major lessons learned follow.

-Bridge assets are required at the corps and division levels. The exercise validated the flexibility that corps-level bridging assets offer the corps commander in influencing the battle. Several times during the exercise, two or more divisions simultaneously requested additional bridging assets. The corps commander must be the person to decide where to employ such a valuable—but relatively scarce—combat multiplier for maximum operational benefit.

The exercise also validated the relative amount of bridging assets held at corps versus the number held at division. While at one point (TF Remagen) all divisional and corps float bridge assets were to be controlled by the 565th Battalion Headquarters, the 60-40 mix appears to provide both responsive support to the division commander as well as flexibility at the corps level. Control of medium girder bridging and supplemental bridge assets need to be retained at corps level.

-Battalion-level command and control is required for corps-level bridge companies. The need for a bridge battalion (versus several separate companies) came under careful scrutiny. The exercise underscored the absolute need for such a battalion within the force structure. When the separate companies were attached directly to a group or brigade headquarters,

Task Force Remagen

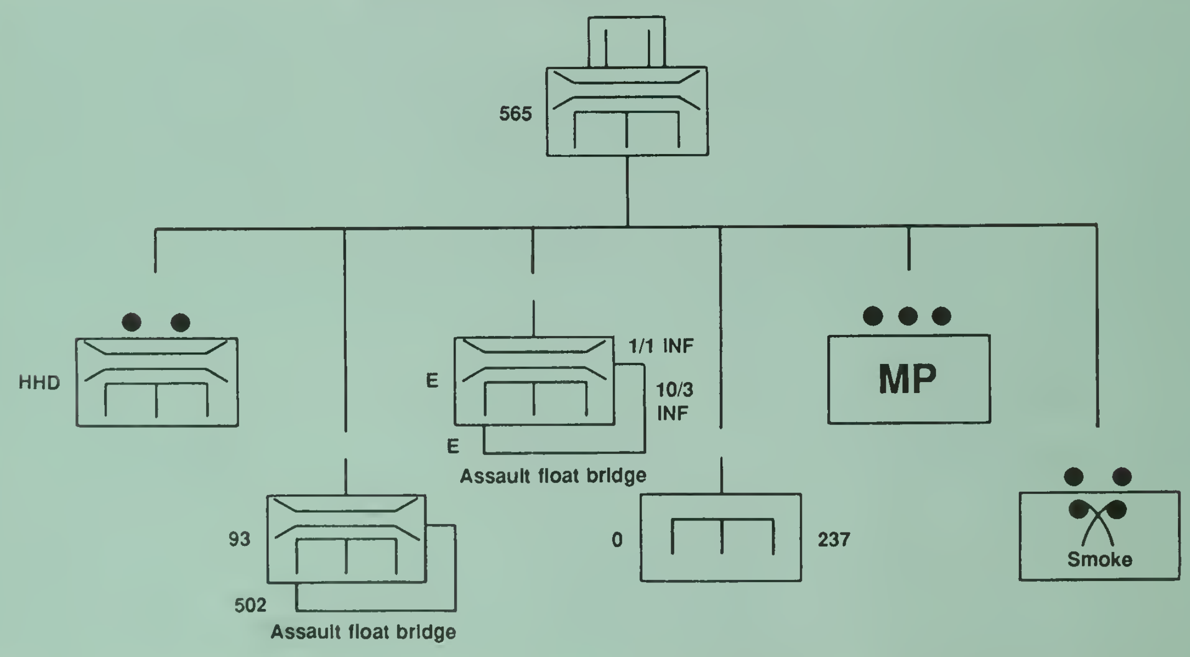
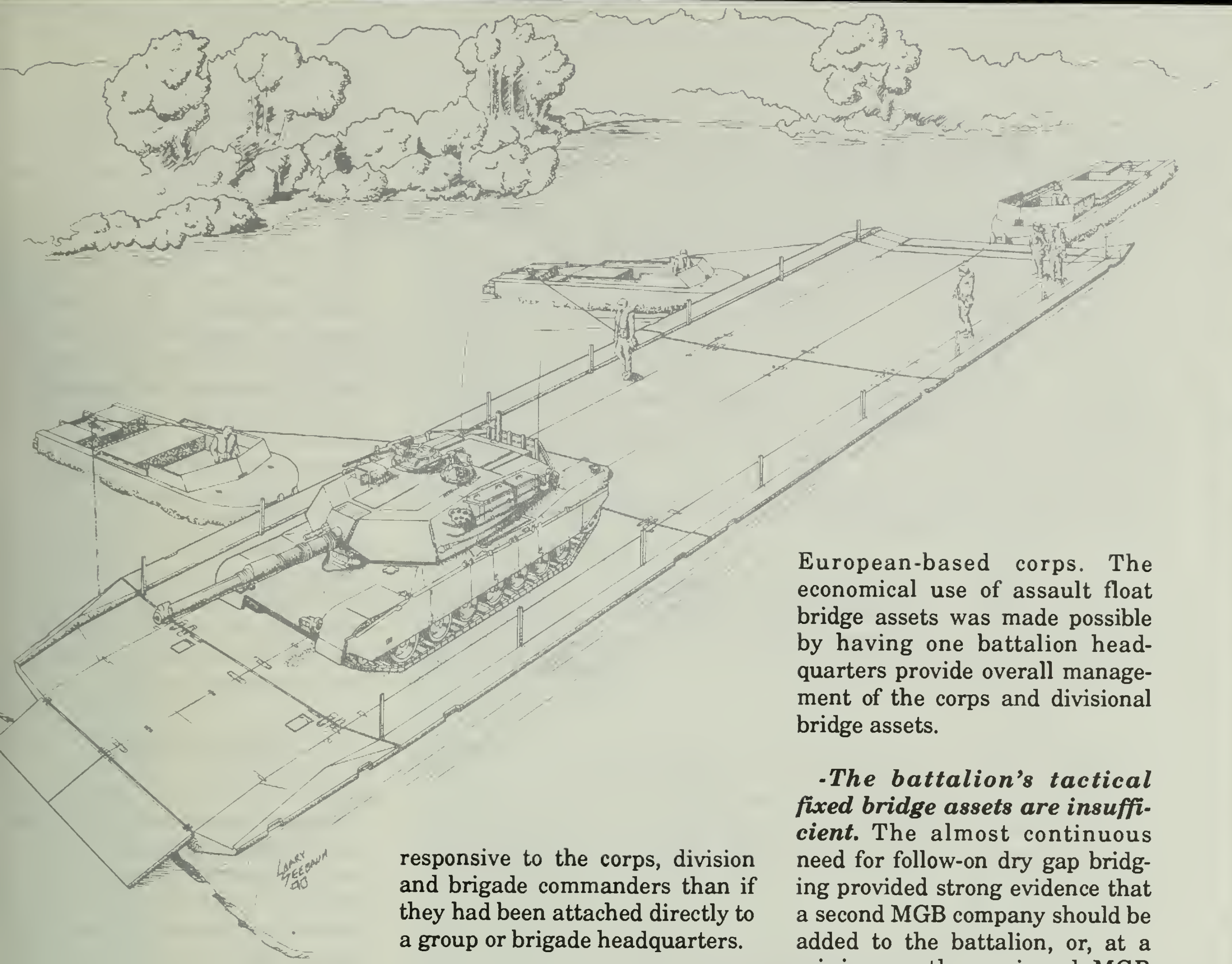


Figure 3



they were often neglected or poorly employed. The rapid pace of the battle, and the maneuver elements' urgent need for engineer support, nearly always forced the senior engineer command and control headquarters to focus their attention on the activities of their combat engineer battalions located in the forward areas.

In contrast, the bridge battalion concentrated on projected bridging requirements and the special needs of its bridge companies. As a result, the senior headquarters was freed of this responsibility and could better concentrate on the forward battle. In addition, the interjection of a battalion headquarters for command and control purposes enabled the bridge companies to be considerably more responsive to the corps, division and brigade commanders than if they had been attached directly to a group or brigade headquarters.

-Maneuver units require river crossing expertise. The unique river crossing expertise found in the battalion proved invaluable in planning river-crossing operations. The planning support required by the maneuver units during the exercise simply surpassed the companies' ability to provide it. In addition, two ad hoc maneuver organizations, the crossing force and crossing area headquarters, required all the planning and operational support they could get.

-The battalion's assault float bridge assets are appropriate. While there were extensive requirements for river crossing operations, three corps-level assault float bridge companies appear to be appropriate for a European-based corps. The economical use of assault float bridge assets was made possible by having one battalion headquarters provide overall management of the corps and divisional bridge assets.

-The battalion's tactical fixed bridge assets are insufficient. The almost continuous need for follow-on dry gap bridging provided strong evidence that a second MGB company should be added to the battalion, or, at a minimum, the assigned MGB company should have a third MGB platoon. Only the active use of the bridge park's assets enabled the MGB company to meet its tactical fixed bridging mission in a responsive manner. The formation of a bridge park within the 565th Engineer Battalion proved to be a "wartime" necessity for backup float and tactical bridge assets.

-Corps bridge units need to prepare for the rear area battle. Corps-level bridge units will occasionally be located in the corps' rear area. Engineer units often fail to train sufficiently for this mission.

-The bridge battalion headquarters provides flexibility to the engineer brigade commander. While the primary responsibilities of the bridge battalion headquarters are to command and control its companies and to provide bridging expertise and assistance, it proved its versatility and flexibility by performing other important missions. These included assisting E Company, lst Engineer Battalion, in implementing a training program; assisting a group headquarters in transitioning into the European theater; acting as a task force headquarters (TF Remagen) to accept additional units for a large river crossing operation; supporting allied units with bridge assets; providing interoperability between allied bridging organizations, and performing the role of a base cluster command group for rear area operations.

Conclusions

Exercise Certain Challenge proved a valuable testbed for the engineer bridge battalion. The organization and employment of the battalion were validated. Only minor adjustments were needed to improve the current concept. More importantly, it showed the flexibility, capability, and responsiveness that a bridge battalion can provide maneuver commanders on future battlefields.

Lieutenant Colonel Munch commands the 565th Engineer Battalion, the only Active Component bridge battalion in the U.S. Army. He has served in various command and staff positions throughout Germany, Korea and the United States. A graduate of Virginia Military Institute, he holds a masters degree in civil engineering from Georgia Tech. He is a graduate of the Command and General Staff College.

Bridge Battalion Strengths...

Bridging Expertise. Throughout the exercise there was a constant demand for operational expertise in river crossing operations. Elements from the battalion headquarters provided in-depth expertise to other engineer and maneuver headquarters.

Command and Control. Separate engineer companies tend to be used ineffectively when they report directly to a brigade or group headquarters. The nature of the bridge battalion headquarters allowed it to anticipate and plan for river crossing and tactical fixed bridge operations, and then oversee the proper execution of the mission.

Flexibility. The bridge battalion successfully performed a variety of missions throughout the corps area. These ranged from acting as a task force headquarters and accepting additional units in the forward area, to acting as a base cluster command group in the corps' rear area.

Capabilities. The battalion had sufficient assets to build six spans across the Main River, construct six 20-meter medium girder spans, and provide ample replacement bridging. In addition, the battalion showed that it could adequately transport 840 tons of material per lift. By any definition, this is a formidable capability.

And Weaknesses

Limited Support for Crossing Area and Crossing Force Headquarters. The battalion could provide staff engineers for only two headquarters outside its own and then at extreme degradation to its own capabilities. The battalion needs to explore better ways of providing bridging expertise to other headquarters.

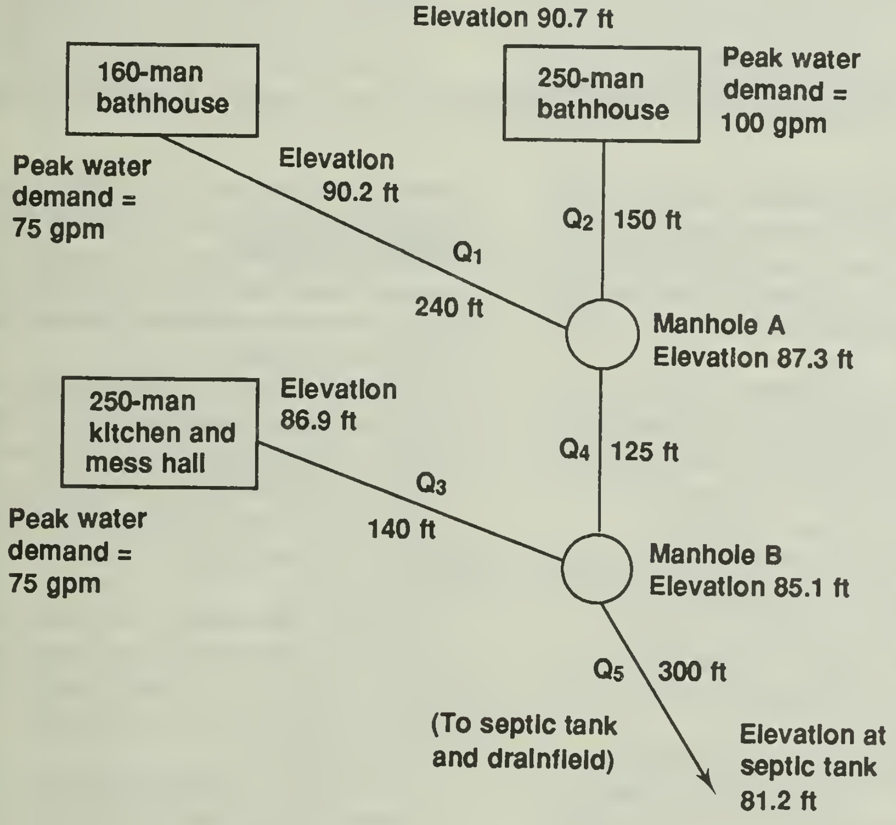
Communications. With units spread across the entire corps area, the battalion lacks sufficient long-range communications. The battalion needs more extensive communications support, and must develop procedures to allow subordinate elements to operate with a minimum of guidance from the headquarters.

Rear Area Support. The battalion was marginally prepared to perform rear area missions. More specific engineer doctrine and better training at the battalion level is required.

Engineer Problem

You are given a sewer layout for a 250-man contonement area in a theater of operations environment. Your task is to determine the total sewage flow rate and the size of septic tank required to handle the waste from this installation. The following specifications and conditions apply:

- Infiltration rate is 2 gallons per minute (gpm) per 1000 feet (ft) of sewer line.
- Total daily water demand for this facility is 4250 gallons per day (gpd).
- Selected depth for the septic tank is 5 ft plus 1 ft freeboard.
- Selected length for the septic tank is 2.5 times the width.

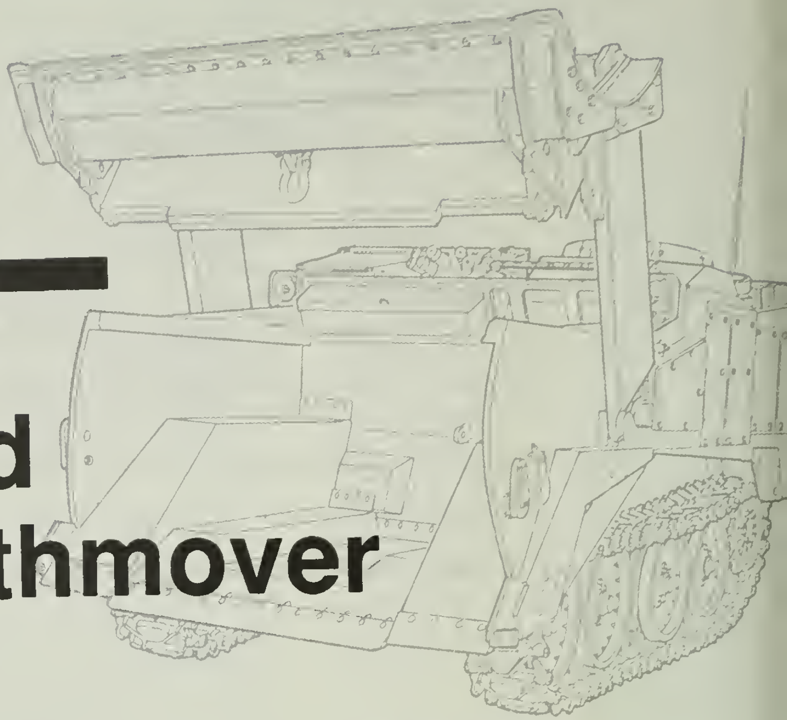


Reference: FM 5-163

Engineer Solution on page 27.

ACE—

The Armored Combat Earthmover



By Lieutenant Colonel Robert J. Sperberg and Captain Craig S. Pickett

The warfighting capabilities of the United States Army have vastly improved over the last few years, due in no small measure to a new family of fast and lethal combat vehicles like the M1 tank and the M2 Bradley.

Until recently though, the combat engineer was hard pressed to keep up with the accelerated pace of armored warfare. The survivability and cross-country speed of the new armor and infantry vehicles far outstripped engineer mobility.

All of that began to change in September 1989 when the Army received its first shipment of the M9 Armored Combat Earthmover (ACE). The first delivery of 19 ACEs went to the Engineer School at Fort Leonard Wood to support operator and maintenance training programs.

The product of many years of research and development, the ACE will prove to be a valuable asset throughout the spectrum of conflict. This high speed, amphibious, armored vehicle is capable of supporting both offensive and defensive operations. Its cross country capabilities will allow it to accompany maneuver forces, providing mobility, countermobility and survivability support.

Design features of the vehicle make it a valuable combat multiplier for maneuver commanders. And despite its versatility, the ACE has a single crew member who can perform all tasks from inside the driver's compartment. The ACE can prepare hull-defilade firing positions and dig in other battlefield systems to improve their survivability. In combat, the vehicle's armor protects the driver and the engine compartment from artillery shrapnel and small arms fire up to .50 caliber.

Eight cubic yards of soil or rock, palletized ammunition, mines, protective wire or other materials can be loaded and hauled in the vehicle bowl. The ACE's hydropneumatic suspension allows it to "kneel down" and self-load the bowl, and another on-board system allows it to unload without assistance.

The ACE has towing capabilities similar to the M817 5-ton dump truck, allowing it to pull supply trailers and other equipment forward on the battlefield. It also has a winch capable of pulling up to 30,000 pounds.

The vehicle is capable of traveling 30 mph on roadways, and it can swim 3 mph in still water. Its cross country mobility is compatible with the M1 and M2.

Army plans call for the purchase of over 500 ACEs for fielding with Active, Reserve and National Guard units. In addition to the vehicles already assigned to engineer training units at Fort Leonard Wood, the Army's initial fielding plan for the ACE currently calls for deliveries to Fort Ord and the National Training Center at Fort Irwin.

Units in Europe would then receive priority of fill under present fielding strategies. Some vehicles would also be alloted to the European Prepositioning of Materiel Configured to Unit Sets (POMCUS) program.

With the arrival of the ACE, the job of training our soldiers on this new system has just begun. Training programs on the ACE geared up at Fort Leonard Wood with the arrival of the first vehicles last September. Instruction has been divided between the courses for Engineer Tracked Vehicle Crewman (12F), and Engineer Construction Equipment Repairer (62B). Courses are held at both the Advanced Individual Training (AIT) and the Basic Noncommissioned Officer (BNCOC) levels. Fort Leonard Wood's 87th Engineer Battalion is responsible for ACE instruction.

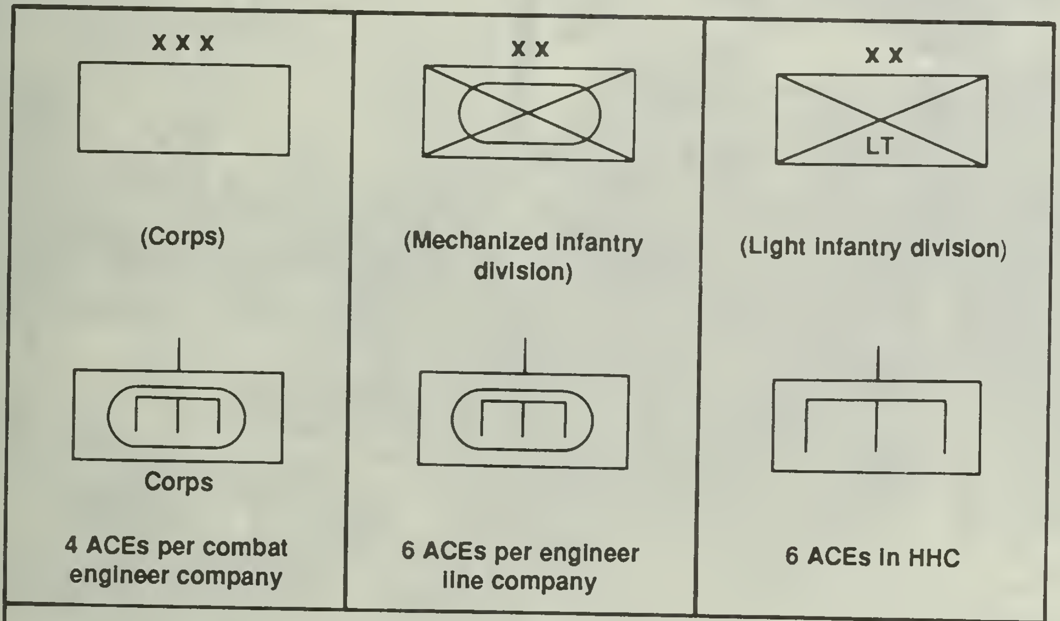
12F AIT

Skill level one 12F MOS soldiers are the primary operators for the ACE. Extensive classroom instruction on vehicle capabilities and utilization, and more than 40 hours of hands-on training teaches them the skills and knowledge they need. Major points of instruction include the following:

- ▶ Start/stop engine and drive
- ▶ Perform tilt dozing
- ▶ Prepare for air transport
- ▶ Perform winch operations
- ▶ Load/unload bowl
- ▶ Perform straight dozing/rough grading
- ▶ Operator preventive maintenance checks and services
- ▶ Prepare for deep water operations
- ▶ Load/unload palletized cargo
- ▶ Emergency maintenance procedures
- ▶ Operate during night hours
- ▶ Field training exercise (with hull defilade position, tank ditch and obstacle removal)

During their training, students are taught how to build and remove critical battlefield obstacles in conjunction with the Combat Engineer Vehicle (CEV) and the Armored Vehicle Launched Bridge (AVLB). A combined arms training exercise (CATEX) wraps up the 12F training program. In the CATEX, ACE operators join Combat Engineers (12B) and Bridge Crewmen (12C) in a simulated combat environment.

M9 Initial Issue to Major Units


x x x
(Corps)
Corps
4 ACEs per combat engineer company
x x
(Mechanized infantry division)
6 ACEs per engineer line company
x x
LT
(Light infantry division)
6 ACEs in HHC

Six ACEs will be allocated to each engineer company in separate heavy engineer brigades, four per engineer company in separate infantry brigades and six in each engineer company in the armored cavalry regiments.

The 12F soldiers then are tested on their ability to support the engineer task force commander in a battlefield scenario.

12F BNCOC

The BNCOC 12F course provides junior NCOs with more than 16 hours of training on vehicle operations and employment, as well as instruction on supervising ACE operations. Students become familiar with the location and function of major components, the vehicle's technical capabilities, and the different types of missions that the ACE is capable of performing.

62B AIT

The ACE, unlike most engineer equipment, requires special maintenance skills. For example, the ACE's road wheels are hydraulically controlled with a sophisticated hydropneumatic suspension system. Primary maintenance of the vehicle will fall to the Construction Equipment Repairer (MOS 62B). These soldiers are taught to identify the purpose, location, function and appropriate repair of the ACE's major components. Instruction includes nearly 40 hours in the following areas:

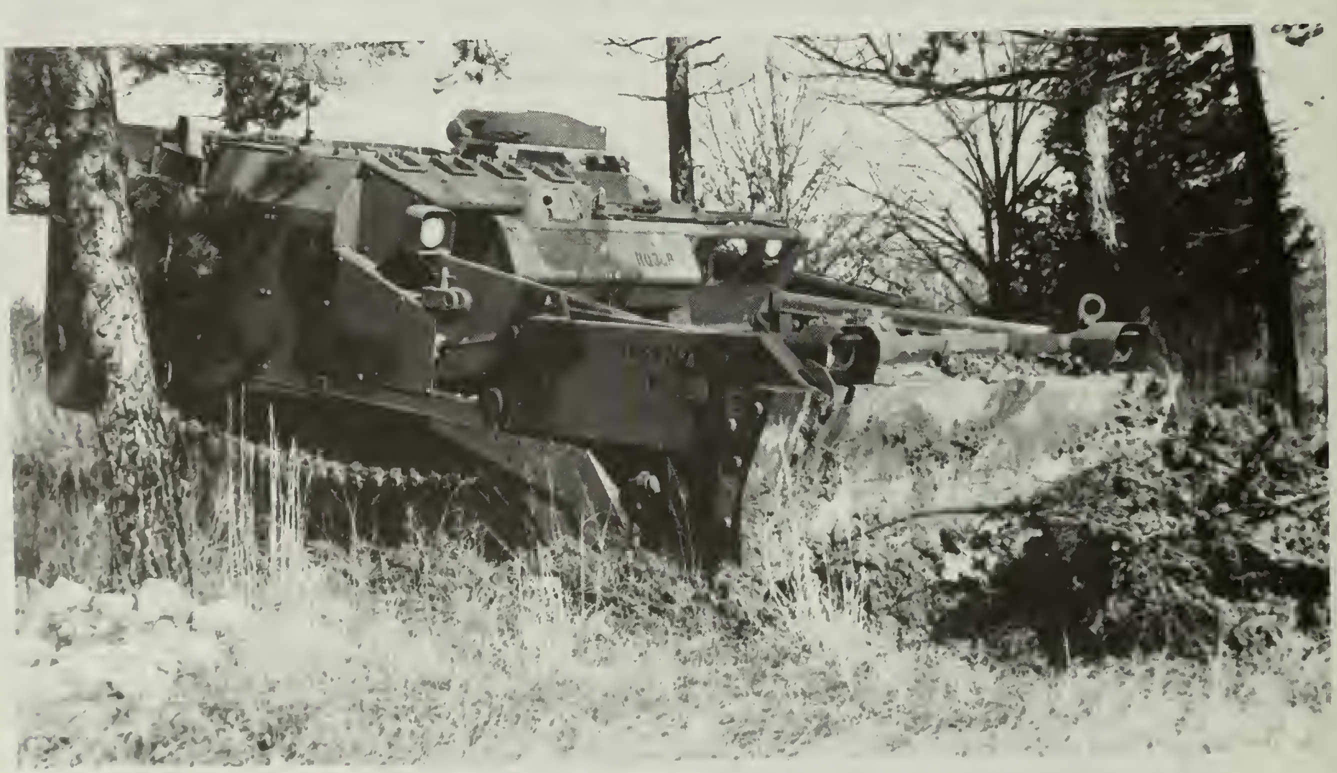
- Road wheel removal and installation
- Track tension adjustment
- Drive shaft removal and installation
- Final drive removal and installation
- Steering unit torque link removal and installation
- Steering unit brake lever adjustment
- Charge suspension accumulators
- Charge transmission accumulators
- Charge main hydraulic accumulators

62B30 BNCOC

The maintenance supervisor for the ACE will be the Senior Construction Equipment Repairer (MOS 62B30). These NCOs are trained in the vehicle's capabilities, purpose, and unique safety requirements. They will also become adept at applying technical skills and knowledge to isolate complex equipment malfunctions. The training they receive will enable them to successfully supervise subordinates to ensure the safe and effective maintenance of the ACE.

ACE Training Team

To help ensure the smooth transition of the ACE into units at other posts, the Engineer Center has formed a New Equipment Training Team (NETT). The team, staffed with four 12F NCOs from the 87th



An M9 Armored Combat Earthmover (ACE) prepares a hull-defilade fighting position during training at Fort Leonard Wood. The tracked, amphibious ACE allows the single crewmember—here "buttoned-up" in his compartment—to perform a wide variety of missions from inside the vehicle (Photo by Phil Howell).

Engineer Battalion, will train unit operators and instructors.

The NETT will provide classes and hands-on instruction on the ACE's capabilities, technical characteristics, and anticipated missions. Target personnel include junior enlisted and NCOs, platoon sergeants, platoon leaders and commanders.

Junior NCOs, specialists and privates will receive 80 hours of operator training. The objective is to teach basic skills in preparing anti-tank ditches, fighting positions, preparing the ACE for amphibious operations, and other 12F10/20 ACE tasks. These soldiers will also be told how to perform preventive maintenance on the vehicle.

Platoon sergeants, platoon leaders, commanders and staff will receive 12 hours of training on the tactics of employing the ACE. The team will also cover areas such as vehicle characteristics, combat mobility, and use of the ACE in countermobility and survivability missions. This training will stress the warfighting capabilities of the ACE and its significant combat advantage over the bulldozer.

The ACE has begun to take its place on the Army's combined arms team. This vehicle can move with the M1 tank and M2 Bradley, and gives field commanders an engineer combat multiplier never before available. With its tactical speed and armor protection, it will be able to respond rapidly to mobility, countermobility and survivability missions.

The capabilities of this new engineer marvel are such that its uses are limited only by the foresight of commanders and engineers, and the skill of the operator.

And with the training our soldiers are now receiving, commanders can be confident that the ACE can handle any battlefield obstacle standing in the way of tactical success.

Lieutenant Colonel Sperberg is the commander of the 87th Engineer Battalion at Fort Leonard Wood. He is also the training captain for 12F and 62B training. He previously served as executive officer, Assistant Chief of Engineers, Department of the Army. He holds a bachelor's degree in civil engineering from Virginia Military Institute, and a master's degree in engineering administration from George Washington University. He is a registered engineer in Virginia.

Captain Pickett is the commander of A Company, 87th Engineer Battalion. His most recent assignment was as chief, 12F Training Committee, Fort Leonard Wood. He is a graduate of the Engineer Officer Advanced Course and holds a bachelor's degree in business management from Shaw University, North Carolina.

Private Mario Daniels, a student in the Construction Equipment Repairer (MOS 62B) course at Fort Leonard Wood, adjusts a bolt on an ACE engine. Soldiers in the 62B field will have primary responsibility for maintenance of the ACE's sophisticated mechanical systems (Photo by Phil Howell).

Moving Mountains

When Army engineers in Panama were assigned the job of taking off the top of a mountain in Bolivia, they didn't bat an eye. They just got busy.

Soldiers from the 536th Engineer Battalion at Fort Kobbe, Panama, were deployed in June 1989 to Potosi, Bolivia, for the Joint Chief of Staff exercise Fuerzas Unidas 89. The 90-day mission called for removing the top of a mountain near the Potosi airport to allow commercial airliners to use the landing strip.

The engineer task force included Seabees from the Naval Mobile Construction Battalion 40, stationed at Port Hueneme, California, an Illinois National Guard medical team, and other support elements from Panama. In addition, the Bolivian government augmented the exercise with an engineer company, an infantry company, and pilots from the Bolivian Air Force.

Lengthening the runway for larger commercial aircraft is designed to improve the local economy by expanding the tourist industry in Potosi, one of the most historic places in South America.

"Potosi is one of the oldest communities in the Western Hemisphere," said Major F. Marion Cain, III, commander of the task force. "Long before Christopher Columbus discovered America, Potosi was a thriving city of more than 100,000 people. All the silver that financed the Spanish Armada came from Cerro Rico, meaning 'Rich Mountain,' which is located just outside Potosi."

"We needed to remove about 200,000 cubic meters of soil from the hill that obstructs the glide slope and approach zone into the Potosi airfield," said Cain.

"Decreasing the glide slope to 4 percent is necessary for the safety of approaching aircraft, especially at 13,500 feet," Cain continued. It will also allow the Bolivian government to later lengthen the runway 500 meters. When that's complete, they should be able to land small jets like 727s and 737s."

The high altitude of the site was the first big challenge the task force faced. The difference in elevation between Panama and the Potosi field was nearly 14,000 feet.

"Moving from sea level to almost 14,000 feet, we didn't really know what to expect from altitude-related sickness," said Dr. (Major) Gene Iwanyk, task force surgeon. "Although they were briefed on the signs and symptoms of high altitude [sickness], it affected each soldier differently. One case, which was originally diagnosed as stomach cramps, turned out to be sickle cell crisis. The soldier had to be evacuated to Panama. Of approximately 350 soldiers deployed to Potosi, four had to be evacuated due to the altitude."

The harsh conditions and isolation of the Potosi project took their toll on the engineers. "The task force underestimated the brutal nature of the project," said Lieutenant Colonel Peter A. Topp, battalion commander.

Rocky terrain full of large boulders beat up civilian rental equipment, and the sturdier Army equipment suffered from a lack of repair parts. Cain said the task force fleet strength dropped as low as 60 percent during the deployment.

A 536th Engineer Battalion bulldozer "feeds" dirt to a scoop loader, increasing the loader's performance near the Potosi airport, visible in the background. The engineers moved 200,000 cubic meters of dirt during the joint American and Bolivian project (Photo by Specialist Bob Blocher).

"The civilian equipment is not built to the specifications we need to do the job," explained CW2 James Logan, chief of maintenance at the Potosi site. "Their dump trucks couldn't handle this kind of work. The trucks' aluminum drive shafts are prone to snap, and they have only a single lift cylinder for dumping," he said. "Any load variation from side to side, like hauling boulders, could easily put a truck out of commission. However, the [Bolivian] civilian contractor did a good job of maintaining his equipment."

The sturdy Army equipment, on the other hand, suffered from a painfully long supply line.

"Repair parts normally stocked in Panama were inadequate to support equipment operating in the extreme environmental conditions in Potosi," said Major Greg Davis, battalion executive officer. "When repair parts were available in Panama, the task force received them within a week. However, it took at least three weeks to get parts from the United States."

"Being at the 'end of the world,' it was tough to get parts," Logan concurred.

To keep Army equipment rolling despite the lack of parts, maintenance teams pulled together and

Army Engineers in Bolivia

By Specialist Bob Blocher
and Captain Louis Herrera

"...the work of the engineers, like the friendships, will endure for a long, long time."

used ingenuity and hard work to solve the problem.

"We'd learn how to fabricate parts," Logan said. "If a part was broken, instead of replacing it, we'd weld it back together and grind it down to specifications. Our welder got more experience here than he's had in years."

When parts were unavailable and couldn't be repaired, maintenance crews resorted to cannibalizing parts from one broken piece of equipment to repair another.

"We call it controlled substitution," Logan explained. "If two pieces of equipment went down, I'd repair the second with parts from the first. But if a third one goes down, I'd repair the first one so we didn't keep it in the 'bone yard' and turn it into scrap metal."

The large number of boulders at the site forced the engineers to constantly replace dozer end bits and adapt their dozing techniques to the terrain. For example, slot dozing was ineffective because the dozers had to raise their blades to clear boulders, and consequently lost most of their load. However, by dozing against one face of a cut, the dozers achieved the same effect as slot dozing.

As the exercise entered its third month, it became evident that earlier maintenance problems had put the engineers behind schedule. The task force fell behind its scheduled 20,000 cubic meters-per-week production quota, averaging only 16,000 cubic meters per week. Realizing the mission would not be completed at that pace, Cain flew in a second work shift from Panama. Working from 5 p.m. till midnight, the extra shift brought production back on line.

"The reason for the night shift was to catch up on lost time due to equipment failure," said Second Lieutenant Paul W. Benson, officer in charge of the job site. The smaller night crew's main job was to stockpile loose dirt for the main shift's scoop loaders.

"If our big-blade dozer was working, we'd use that to push dirt off the side of the hill," Benson explained. "However, we didn't have enough lights to cover the entire work area, so the other six dozers stockpiled soil for the scoop loader. That increased the loader's performance—some days we'd run 350 to 400 truck loads because the night crew stockpiled."

Stockpiling at night freed bulldozers during the day to accomplish other tasks.

"Having six dozers stockpiling at night saved us production time by allowing us to use only one dozer to stockpile during the day," Benson said. "We could then use the other dozers to push dirt. It allowed us to catch up on lost production time."

The mission of removing 200,000 cubic meters of earth from the path of progress at Potosi was met on time. But it wasn't the only achievement for the task force.

The engineers also succeeded in building a close working relationship with the Bolivian military. The Bolivians were friendly, cooperative, and eager to learn techniques of construction and maintenance from the engineers. Task force members taught Bolivian engineers how to operate and maintain earth moving equipment. Many of the soldiers had never operated a motor vehicle, much less a piece of heavy engineer equipment. Within three weeks of the start of training, 30 Bolivian soldiers were operating and maintaining dump trucks, and 14 knew how to operate and maintain the bulldozers.

Members of the task force medical team and Navy Seabees conducted several humanitarian and civic-action projects. Originally assigned eight civic-action projects, the group was soon flooded with requests from Bolivians throughout the area for more help. The task force provided assistance ranging from construction of a school house and repair of community buildings to conducting medical assistance visits.

The Potosi project provided excellent training under difficult conditions and built a bond between the American military team and their Bolivian hosts. And the work of the engineers, like the friendships, will endure for a long, long time.

Specialist Blocher is a photojournalist assigned to the Public Affairs Office, U. S. Army South, Fort Clayton, Panama. He is a graduate of the Department of Defense Information School.

Captain Herrera currently serves as the S-1, 536th Engineer Battalion. He served as the task force operations officer for exercise Fuerzas Unidas 89. Previous assignments include company executive officer and platoon leader, 16th Engineer Battalion. He is a graduate of the Engineer Officer Basic Course, Infantry Officer Advanced Course, and Ranger School.

Engineer Solution

1. Determine the total sewage flow rate for the 250-man contonement area in a theater of operations environment.

To find the total flow rate, first convert the peak water demand for each building to the sewage flow rate and then calculate the flow rate for each section of pipe using the following equation:

$$Q_T = Q_M + Q_H + Q_I$$

Where Q_T *= total flow into manhole (MH)*

Q_M *= flow from upper manhole (if any)*

Q_H *= flow from facilities (house connections)*

Q_I *= infiltration into the sewer line. (If no infiltration is specified, assume a rate of 2 gpm per 1000 ft of pipe.)*

a. Convert the peak water demand for each building to sewage flow rates. The sewage flow rate from a theater of operations facility is 70 percent of the peak water demand for that facility.

70 percent x 75 = 52.5 gpm (160-man bathhouse)

70 percent x 100 = 70.0 gpm (250-man bathhouse)

70 percent x 75 = 52.5 gpm (250-man mess hall)

b. Calculate the flow rate for each leg of the sewer using the above equation:

$$Q_1 = 70 \text{ gpm} + 150 \text{ ft} \frac{(2 \text{ gpm})}{1000 \text{ ft}} = 70.3 \text{ gpm}$$

$$Q_2 = 52.5 \text{ gpm} + 240 \text{ ft} \frac{(2 \text{ gpm})}{1000 \text{ ft}} = 53 \text{ gpm}$$

$$Q_3 = 52.5 \text{ gpm} + 140 \text{ ft} \frac{(2 \text{ gpm})}{1000 \text{ ft}} = 52.8 \text{ gpm}$$

$$Q_4 = Q_1 + Q_2 + 125 \text{ ft} \frac{(2 \text{ gpm})}{1000 \text{ ft}} = 123.5 \text{ gpm}$$

$$Q_5 = Q_3 + Q_4 + 300 \text{ ft} \frac{(2 \text{ gpm})}{1000 \text{ ft}} = 176.9 \text{ gpm}$$

Answer: The 250-man contonement area has a daily sewage flow rate of 176.9 gpm.

Engineer Solution

2. Design the septic tank required to handle the sewage flow for this 250-man contonement area:

Given: Total daily demand (TDD) = 4250 gpd
Depth of septic tank = 5 ft

a. Design flow = *4250 gpd x 70 percent = 2975 gpd*

b. Volume of septic tank = $\frac{2975\ gpd}{7.48\ gal/ft^3} \times 1.25 = 497.2$ cubic feet (ft^3)

NOTE: For sludge storage, increase the volume of a septic tank by 25 percent (multiply by 1.25). (para 2-6a, FM 5-163)

c. Length of the septic tank is 2 1/2 times the width.

$L = 2.5(W)$

NOTE: In a theater of operations, the length of a septic tank should be two to three times the width. If not specified, the assumed length is 2.5W.

d. $V = L \times W \times D = 2.5(W) \times W \times 5\ ft = \frac{497.2\ ft^3}{(2.5)(5)} = W^2$

Answer: **W = 6.3 ft**
L = 2.5(6.3 ft) = 15.75 ft
D = 5 ft plus 1 ft of freeboard

This Engineer Problem/Solution was submitted by Captain John W. Brown III, who is an instructor and subject matter expert for the Structures and Utilities Branch, Department of Military Engineering, U.S. Army Engineer School.

LESSONS LEARNED

Engineer Program Expansion Planned

by Captain Neal T. Lovell

If you want to reap the benefits from accumulated background information and experiences pertinent to your next mission, use the Lessons Learned program at the Engineer School. Consider the following scenario.

Division just tasked your unit to deploy to Dirkou, Nigeria, to construct a 1600 meter airfield. Nobody in he division has been to Nigeria or knows where Dirkou is. As the assigned deployment action officer, you should:

(a) Call branch for an immediate transfer

(b) Delegate the action and go on an extended eave

(c) Call the Lessons Learned Branch, Directorate f Evaluation and Standardization (DOES), at the Engineer School

Your leave was rejected. While item (c) may not e your first action, contacting the Lessons Learned Branch should be high on your list of things to do. You need to gather "lessons learned" and other background information regarding deployments to ligeria, airfield construction, and nation building exercises. This step will enable your unit to avoid epeating mistakes or problems encountered by units n similar situations and will help ensure mission uccess.

The Lessons Learned Branch of DOES, which manages the program at the Engineer School, has he mission to collect, analyze, and disseminate this type of information to units throughout the Army. Upon request, they provide lessons learned related o a specific technical topic or geographical area to ndividual units worldwide. Requests normally are lled quickly, often within a few days, and replies may be sent either electronically or via mail. The program is currently being expanded to better meet ser needs.

As part of the expansion process, DOES requests our assistance in obtaining after action reports AAR) related to engineer-specific lessons learned. uch AARs are key documents that provide the asis for individual lessons learned. To help in this ata-collection process, unit commanders and others re urged to send AARs to:

Commandant
U.S. Army Engineer School
ATTN: ATSE-ESA-L
Fort Leonard Wood, MO 65473-6630

The centerpiece of the Lessons Learned program is a database of information collected from sources throughout the Army. The information is used to analyze engineer trends in areas such as doctrine, training, leadership, organization, and materiel. Results are published in special reports and studies as well as the *ENGINEER Professional Bulletin.*

Besides AARs, information in the database is gathered from such sources as—

- National Training Center (NTC)
- Joint Readiness Training Center (JRTC)
- Combat Maneuver Training Center (CMTC)
- Battle Command Training Program (BCTP)
- Center for Army Lessons Learned (CALL)
- Personal interviews
- Historical studies

These sources provide a broad range of topics that are applicable Army-wide, but the information is not engineer specific or obtained from the grassroots level of the engineer community.

When submitting an AAR, DOES recommends that the standard format described in Army Regulation 11-33, Army Lessons Learned Program: Systems Development and Application be used.

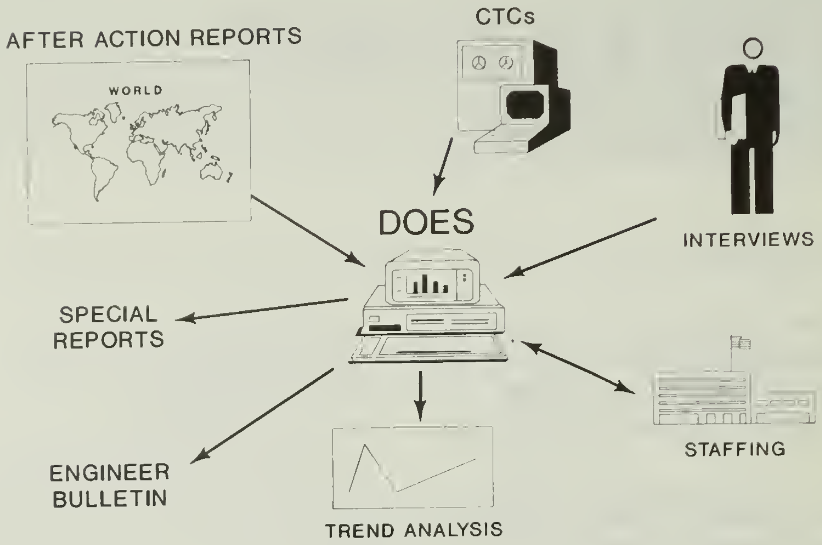
Part I: Executive Summary (Completed by commander)

- Mission/objective
- General description
- Dates, locations, and major participants
- Significant issues
- Limitations

Part II: Lessons Learned

- Observations
- Discussion
- Lesson learned
- Recommended action
- Comments

ENGINEER LESSONS LEARNED SYSTEM



Part III: Optional

- Chronology of events
- Operation plan (OPLAN) or operational order (OPORD)
- Standing operating procedure

AARs received at the Engineer School are reviewed by appropriate staff and all unit identifications are removed before any lessons learned are published. References to units and other Identifications are deleted to ensure confidentiality and objectivity throughout the staffing and publication process.

The review process is designed to validate the information and channel it to the appropriate organization within the Engineer School and Center. Only validated observations are used to review and correct engineer doctrine, training, leadership, organization, and materiel.

When necessary, DOES contacts a unit to obtain information in addition to that in the AAR. Occasionally school personnel conduct pre-deployment interviews for special data collection efforts. These are performed for unusual projects, such as paving in a theater of operations or major construction efforts.

Some information is obtained by DOES personnel during special request, on-site visits to deployed units. When invited by either a deploying unit or a major Army command, personnel from DOES travel to a site, as funding allows.

Significant issues gathered from all sources by DOES are staffed to subject matter experts within the school. They provide an appropriate "school solution" and then the information is entered into the school's lessons learned electronic database. Some issues are added to classroom and hands-on training in resident courses and will be integrated into future doctrinal publications. Validated lessons learned are forwarded to CALL for inclusion in the Army's Lessons Learned database.

The following examples typify the kind of information provided by the Lessons Learned program.

ISSUE: Construction projects lack quality control.

DISCUSSION: Construction projects are most likely to lack quality control when supervisors are absent. Quality is also degraded when soldiers are not concerned with their work, rely mainly on experience from past projects, or ignore current specifications.

SOLUTION: To ensure quality control throughout a construction project, supervisors must—

- Remain on site during construction.
- Be thoroughly familiar with specifications for the work to be accomplished.
- Enforce construction standards.
- Appoint a team to inspect construction throughout the project.
- Define a chain of command for each submission.
- Ensure the S-3 construction section determines, in advance, construction standards for the project. These standards must relate to the type of design/construction, i.e., hasty/deliberate, temporary/permanent, 1 year/10-20 years.
- Use the construction standards to develop unit quality control (QC) plans.
- Train QC personnel in expedient inspection methods to ensure specifications are met without construction delays.

ISSUE: Plan for adequate drainage during construction regardless of climatic conditions.

DISCUSSION: Climatic data for a region indicated that less than 1 inch of rain normally falls during the period March-April. Therefore, the construction plans for an airstrip to be built in March and April did not include a drainage plan adequate for heavy rains. When the airstrip was nearly finished, it rained for five days. Even though drainage was adequate in most areas and the strip sustained little damage, the Air Force would not use the newly constructed, wet airstrip.

SOLUTION: To lessen the damage and improve the wearing surface, mix river sand and gravel into the surface of an airstrip.

In the long run, the rain caused a better airstrip to be built because natural drainage patterns were revealed and the unit gained an appreciation for the magnitude of tropical rainstorms.

Engineer lessons learned are published in each issue of the *ENGINEER Professional Bulletin*. Some future articles may center around a theme, such as "Construction in Latin America" or "Breaching Operations at the National Training Center" instead of the shotgun approach used in the past.

When warranted due to safety concerns, operational necessity, or major exercise results, DOES will publish special reports. A report concerning Southern Command experiences is planned for late 1990.

Trend analyses, the latest type of lessons learned material, have been used successfully for combat forces. Trend analysis studies for engineers are planned for low intensity conflict (LIC) and nation building lessons learned from SOUTHCOM exercises. As trends are identified, they will be distributed either as articles, bulletins, or special reports.

The Lessons Learned program at the Engineer School provides a valuable service to engineer units throughout the Army. With your assistance, the program will grow and will continue to provide units and soldiers with data needed to accomplish missions successfully.

The ENGINEER Writer's Guide

We think engineers take a special pride in their profession, and *ENGINEER* is always looking for articles from readers who want to share their expertise, experience and ideas.

If you're a potential contributing writer, here are a few "writer's guide" tips that should help steer you in the right direction:

Articles can cover engineer training, operations or doctrine, engineer equipment, history, or other areas of general interest to an engineer readership.

We're especially interested in articles that have a "how-to-do-it-better" theme. For instance, we're not looking for articles telling readers how you conducted a routine field exercise. But if you think you have a "new-and-improved" way of conducting a tactical operation, training exercise, or other operational procedure that may prove helpful to other engineers—that's what we need.

Articles should generally come from contributors with first-hand experience with the subject being presented.

Avoid theatrical writing styles like: "It was a dark and stormy night...," or "...the soldier blazed through the jungle on his lumbering D7, providing a trail of freedom for the other vehicles...."

Articles should be concise, straightforward, and in the active voice.

Length should range between 1,000 and 3,000 words, and the text should be typewritten and double-spaced. Generally, each such page will contain from 200 to 250 words.

Articles containing attributable information or quotations not referenced within the story should carry appropriate footnotes.

Manuscripts must be original, unpublished, and not under consideration by another publication. Normally, you can expect a reply to your submission within two weeks after we receive it.

All submissions are subject to editing.

Contributors are encouraged to include black-and-white photos, artwork, and/or line diagrams to help illustrate your article.

Include your full name, rank, current unit and job title. Also include a list of your past assignments, experience and education, your mailing address, and daytime phone number—preferably Autovon. Send your articles to: Editor, *ENGINEER Professional Bulletin*, ATTN: ATSE-TDM-PB, Fort Leonard Wood, MO 65473-6650.

If you have any questions about an article you're working on—or considering writing—give our features editor, Phil Howell, a call at Autovon 676-7532, or commercial (314) 563-7532.

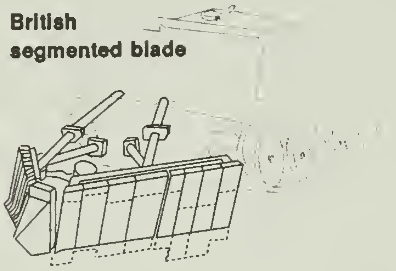
We look forward to hearing from you.

P.S.* ENGINEER *is planning to start a Letters to the Editor column soon, and correspondence from our readers is welcome.

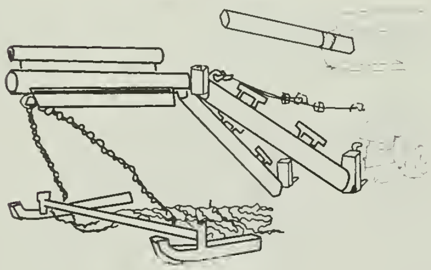
ENGINEER UPDATE

Directorate of Combat Developments (DCD)

British segmented blade



French DRAC



Scatterable Mine Clearance Device (SMCD) Input Requested. User interest is required for continued involvement in a program to provide improved countermine capability to the maneuver force. In an effort to provide this capability, the U.S. Army Engineer School worked with NATO countries to develop a simple, inexpensive, lightweight system to clear scatterable mines. Six possible SMCDs were evaluated; two were retained: the British segmented blade and the French DRAC. Both allow clearance of scatterable mines by main battle tanks or APCs. We may select a system if the need for an SMCD is determined. Send your comments to U.S. Army Engineer School, Attn: ATSE-CDM-M (Jim Smith), Fort Leonard Wood, MO 65473.

Bridging the Gap to the 21st Century. To meet the growing demand for heavy main supply route (MSR) bridging, DCD and the Belvoir Research, Development and Engineering Center are developing a heavy dry support bridge (HDSB). This totally new approach to fixed bridging takes advantage of state-of-the-art materials and design to provide a 45-50 meter, military load class 96 bridge that can be constructed by 8-10 soldiers in about an hour. Such a bridge is needed to bear the weight of heavy equipment transporters loaded with battle damaged tanks (about 96 tons). Plans are to field the bridge by the year 2000. POC is CPT Mike Wickman, AV 676-7334.

Vehicle Driver and Fuel Handler Positions To Be Converted. Headquarters, Department of Army, has approved the conversion of MOS 88M vehicle driver and 77F fuel handler positions to the predominant MOS in combat units throughout USAREUR. Commanders of combat units see this conversion as a way to increase combat capability by placing more war fighters in front line units, especially if force reductions occur in the future. TRADOC approved an expansion of the conversion plan to include CS and CSS units.

Engineer units will benefit by having more engineers, rather than truck drivers, in selected TOE. The change will also generate more engineer force structure, which may enhance future promotion potential. Fuel handler positions in engineer units will not be converted to engineer MOS. The MACOMS will implement this conversion effort based on personnel management considerations. USAREUR will lead the way by converting them in 1990 and 1991. POC is MAJ Carl Graves, AV 676-7957.

Military Intelligence (MI) School 35D/03 S-2 Conversions Studied. The Combined Arms Combat Development Activity (CACDA) may recode 35D/03 S-2 positions to the predominant MOS within a unit. A change is needed to increase the number of 35D/03 soldiers actually working in military intelligence units. Currently, engineer S-2 positions are filled with either 01/02 MI o ficers or 03 engineer officers. However, engineer officers may lack the clearances and training needed to perform their duties. The Intelligence proponent does not agree with S-2 conversions across the force.

The Engineer School's position is to retain the 35D/03 officers in the S-2 positions because they have the experience, clearances, and training required to access the intelligence networks and collect needed information. POC is CPT Nancy Morton-Linek, AV 676-7242.

Directorate of Training and Doctrine (DOTD)

Engineer Hotline Number Changed. The new telephone number for the Engineer Hotline is AV 676-7324, or (800) 563-7324. If you have an engineering question, call the Engineer Hotline any time—night or day!

Field Manual (FM) 5-232 Update. A change to correct the supersession notice in FM 5-232, *Topographic Surveying*, dated September 1989, has been submitted to TRADOC. Until a decision is made, units are urged to retain their copies of TMs 5-232 and 5-235.

Doctrinal Development Refocusing. Doctrine development in the 1990s will focus on the theme "Doctrine in a Changing Army." We will include users in the initial development and revision process of engineer doctrine, tactics, techniques, and procedures. Users are invited to provide comments and express concerns about the following field manuals, which are scheduled for revision in FY 1990 and 1991.

FM 5-25
5-34
5-36
5-104
5-105
5-163
5-166
FM 5-237
5-330
5-331
5-332
5-541
5-725
20-32

Submit comments on DA Form 2028, "Recommended Changes to Publications and Blank Forms."

Soldier Training Publication (STP) Orders. As of 1 January 1990, STPs are ordered from the U.S. Army Publications Distribution Center (USAPDC), 2800 Eastern Boulevard, Baltimore, MD 21220. For information about an order, call their Hotline: AV 584-2533, or (301) 682-8529.

ARTEP 5-25 Series MTPs Distributed. Mission Training Plans (MTP) have replaced ARTEP 5-25, dated August 1981. ARTEPs 5-025-MTP, 5-025-11-MTP, and 5-025-31-MTP, distributed in November 1989, provide "how-to-fight" information to the following units: HHC, Engineer Battalion, Airborne Infantry Division, TOE 5-25; HHC, Engineer Battalion, Light Infantry Division, TOE 5-155; HHC, Engineer Battalion, Air Assault Infantry Division, TOE 5-215; HHC, Engineer Battalion, Motorized Infantry Division, TOE 5-255; HHC, Engineer Battalion, Airborne Corps, TOE 5-445; and the following companies and their platoons: Engineer Company, Engineer Battalion, Airborne Infantry Division, TOE 5-25; Engineer Company, Engineer Battalion, Light Infantry Division, TOE 5-155; Engineer Company, Engineer Battalion, Air Assault Infantry Division, TOE 5-215; Engineer Company, Engineer Battalion, Motorized Infantry Division, TOE 5-255; and Engineer Company, Engineer Battalion, Airborne Corps, TOE 5-445.

These publications may be ordered from U.S. Army Publications Distribution Center, 2800 Eastern Boulevard, Baltimore, MD 21220.

Department of Topographic Engineering (DTE)

Advanced Noncommissioned Officer Courses (ANCOC) Scheduled. Projected class schedules for the topographic engineer ANCOC for FY 1990 and 1991 are—

Report Date	Class Dates	No. Students
	1990	
8 March	9 March - 10 April	6
	1991	
1 August	2 August - 13 Sept	10
5 Sept	6 Sept - 18 October	9

POC is MAJ Patricia Poulson, AV 676-5715.

Department of Military Engineering (DME)

Professional Registration Program Set for Engineers. The Engineer School has developed a program to help engineer officers obtain their professional registration during their stay at Fort Leonard Wood. The State of Missouri offers the EIT and PE exams in April and October annually. The application deadline for the October 1990 PE exam is 30 July, and the deadline for the EIT exam is 11 September.

Officers with 4 years of engineering experience may take the PE exam while attending the Advanced Course. Contact the Missouri Board of Architects, Professional Engineers and Land Surveyors, P.O. Box 184, Jefferson City, MO 64102, (314) 751-0047. Or, write or call the U.S. Army Engineer School, Attn: ATSE-DME (MAJ Nelson), Fort Leonard Wood, MO 65473-6650, AV 676-5732.

Directorate of Engineer Branch Safety (DEBS)

New Director Welcomed. DEBS welcomed Dennis P. F. Woolsey as director in December 1989. Mr. Woolsey last served at Fort Riley, Kansas, where he was safety director of the 1st Infantry Division and Fort Riley. The DEBS staff is ready and willing to assist with your safety concerns. Call AV 676-5008 or (314) 563-5008.

Engineer Personnel Proponent Office (EPPO)

Regimental Dinner. The annual Regimental Dinner will be held 27 April 1990 in Nutter Field House, Fort Leonard Wood. The dinner will be in conjunction with the Engineer Commanders Conference, which is scheduled 26-28 April.

Engineer Officer/Warrant Officer Directory. The 1990 Engineer Officer/Warrant Officer Directory is scheduled for publication in May 1990. Copies may be ordered from the Government Printing Office, Washington, D.C., by calling (202) 783-3238.

Reserve Component (RC)

Engineer Officer Advanced Course (EOAC-RC) Update. Phases of EOAC-RC to be offered at Fort Leonard Wood in FY 1990 include:

Phase	Dates
I	18-30 March, 18-29 June, 5-17 August
IIIA & B	8-20 July, 22 July-3 August
IIIB	26 March-6 April, 7-18 May, 18-29 June, 30 July-10 August, and 10-21 September

Quotas for these courses must be obtained from either the National Guard Bureau or ARPERCEN.

News and Notes

Reserve Component Engineer Refresher Courses Rescheduled: Three RC engineer refresher courses for 1990 have been rescheduled:

Course No.	Title	Old Dates	New Dates
90 ERC-10	Construction Management	21-22 Apr	14-15 Apr
90 ERC-11	Engineer in River Crossing Planning	28-29 Apr	24-26 Aug
90 SRC	Staff Refresher Course	23-27 Apr	16-21 Sep

For attendance quotas and additional information, call Cathy Holland, Reserve Training Office, AV 676-7832 or Com (314) 563-7832.

EOAC-RC Records Transferred. Effective 1 February 1990, records for the Engineer Officer Advanced Course-Reserve Component (EOAC-RC) were transferred to the Directorate of Evaluation and Standardization (DOES). For information about course enrollment or completion, call AV 676-5292 or (314) 563-5252.

Mobile Training Team Requests. Units desiring information about mobile training teams should write to the U.S. Army Engineer Center, Attn: ATZT-RC, Fort Leonard Wood, MO 65473-5000. Or call AV 581-3181 or (314) 596-3181.

Combined Arms and Services Staff School. Year Group 81 officers who have not yet completed the 9-week Phase II of the Combined Arms and Services Staff School (CAS3) at Fort Leavenworth must do so by the end of FY 1990. Failure to attend may jeopardize promotion and staff college selection. The FY 1990 classes are also open to captains in year groups 82 and later who have completed the advanced course and Phase I of CAS3. For report dates, refer to the Army Training Requirement and Resource System computer network or call the CAS3 Operations Office at AV 552-2113/2601. Direct other questions to LTC Shuler, AV 552-5611, Extension 173.

Two recent changes impact planning for CAS3 completion. First, enrollment in Phase I is now automatic upon graduation from an advanced course. Captains have 2 years following graduation to complete Phase I, the nonresident phase. Second, CAS3 graduation is a prerequisite for enrollment in the Command and General Staff Officers Course, nonresident course. Watch for these and other changes in DA Pam 600-3.

Honorary Colonel of Engineer Regiment Named. MG Charles J. Fiala (Retired) is the new Honorary Colonel of the Engineer Regiment. He replaces LTG Fred J. Clarke (Retired), who has served since June 1986. MG Fiala is a graduate of the U.S. Military Academy and has a masters degree in civil engineering from the University of Illinois. Past assignments include commander, 87th Engineer Battalion, Vietnam; commander, 130th Engineer Brigade, Germany; Louisville District Engineer; Deputy Chief of Staff, Engineer, Headquarters, USAEUR; commander, Fort Leonard Wood; and Chief of Staff, USAEUR.

Engineers as Infantry or
'The Long Way Around'

By James W. Dunn
Office of History, OCE

History records many instances of Army engineers who, from the necessities of the heat of battle, have had to assume the role of infantry soldiers. One of the most demanding of these conversions is the ordeal of Lieutenant Colonel Thomas J. Riggs, Jr., and the 81st Engineer Combat Battalion in the closing months of World War II.

The men of the 81st Engineer Combat Battalion, 106th Infantry Division, awoke to heavy German shelling in the early morning hours of 16 December 1944—the start of the Ardennes counteroffensive, the Battle of the Bulge. The 106th, a division new to the war, had taken over the Schnee Eifel sector of the front from the veteran 2nd Infantry Division on 11 December. On arrival at the unit, the newcomers were told that the front was so quiet that Germans on leave often walked across it to visit friends and relatives behind American lines. This peaceful lull did not last long.

Infantry Duty

That first day, when the 81st's Commander, LTC Riggs, saw his letter companies used as infantry, he prepared the rest of the battalion for that role. Riggs, star tackle and captain of the 1940 University of Illinois football team, graduated in 1941 with a degree in engineering. By that fall he was a second lieutenant in the Army Corps of Engineers.

On the morning of 17 December 1944, Division told Riggs that Combat Command B (CCB), 7th Armored Division, would attack east from St. Vith, Belgium, along the Schonberg Road to relieve pressure on two 106th Regiments, which were cut off in the Schnee Eifel. Riggs, named St. Vith's defense commander, was ordered to hold the road open for an expected CCB attack. Therefore, Riggs moved the task force to a ridge line astride the road about a mile east of St. Vith, where they would meet the Germans.

Riggs' force was in position by noon on 17 December, with the headquarters and service company on the left, north of the road. On the right, south of the road, were the half-strength 168th Engineer Combat Battalion, a corps unit, and remnants from the A Company. In the middle, commanding the road, was a 4-gun platoon from the 820th Tank Destroyer (TD) Battalion. His reserve was the division defense platoon—clerks, cooks, and the division band.

The Battle Begins

Almost immediately, using a daisy chain of mines and bazooka fire, A Company stopped a German tank/infantry probe. About mid-afternoon, a stronger attack came straight down the road. Tank fire knocked out one of the division defense platoon's antitank guns, but TD fire forced the Germans to withdraw. When Riggs called for artillery, he learned there was no such support. Using an air-ground radio, he directed a single P47 plane onto the German tanks; it set one afire and forced the rest to withdraw.

Late on the 17th, some good things happened for Riggs and his small force. At dusk, the lead element of CCB arrived, B Troop, 87th Cavalry Reconnaissance Squadron. That night a forward observer from the 105th Self-Propelled 275th Armored Field Artillery Battalion reached Riggs' command post. Now he had some artillery.

The Germans continued to probe the line through 20 December, but they did not mount any heavy attacks. The 5th Panzer Army was having trouble getting units forward over the congested roads to attack the heavier-than-expected defense east of St. Vith. Riggs walked the foxhole line several times each day, and on the 18th he led the reserve in a counterattack to restore a penetration of A Company's line.

On the 19th, LTC William H.G. Fuller, Commanding Officer, 38th Armored Infantry Battalion, CCB, took command, and Riggs became his executive officer. By that time he left of the line consisted of CB units, while engineers were n the right, south of the road.

Enemy Breakthrough

The final German attack and reakthrough came on 21 Decemer. Heavy shelling began about 3 .m., and LTC Fuller left for St. ith at 6 p.m. to check about posible withdrawal routes. He never eturned, so Riggs was back in ommand.

At 8 p.m., four Mark VI (Tiger) nd two Mark IV German tanks, ith infantry, attacked straight own the road. German flares silouetted four Sherman tanks overing the road, and enemy tank ire knocked out three of them. wo more Shermans rushed up, ut similar tactics resulted in the oss of another one and the rest ithdrew. The road to St. Vith was pen.

When tank fire knocked out iggs' command post, he lost all ommunication with the rear. ending the headquarters personel to CCB with the situation, he ent to the forward positions. Mortar fire knocked Riggs unconscious, and when the Germans overran the final American position they captured him. Riggs became a prisoner of war.

Riggs' Odyssey

Over the next 12 days, Riggs walked 110 miles to a rail center in the German rear, losing 40 pounds off his 6-foot, 4-inch frame. With a deepening desire to know what had happened to his battalion, Riggs tried to escape during an air raid but did not succeed.

Next he was shipped by train to Stalag 4, near Berlin, but when he failed to respond under interrogation, the Germans beat him and shipped him east to a prison camp near Pozan, Poland.

Escaping from that camp after 28 days, Riggs made contact with members of the Polish underground. They hid him until he was turned over to a Soviet Army tank unit as the Russians advanced to the west. He traveled with the Russians for about two weeks and was with them when they captured Warsaw.

From Warsaw Riggs took a 750-mile, 5-day train ride to Odessa. Next he got a ride on an English freighter to Port Said. There, the Red Cross put him aboard a troop ship for Naples, where he finally came back under U.S. Army control.

When the Army wanted to send Riggs back to the United States for medical leave, he objected. Riggs convinced them he needed to be with his battalion, which was still fighting at the front. Finally, in Rennes, France, on 16 April 1945, after being away almost four months, LTC Thomas J. Riggs, Jr., again took command of the 81st Engineer Combat Battalion.

Suggested Reading:

-Dupuy, R. Ernest, *St. Vith: Lion in the Way*, 1949, Infantry Journal Press.

-Beck, Alfred M, Et Al., *U.S. Army in World War II, The Corps of Engineers, the War Against Germany*, 1988, Government Printing Office, Washington, D.C.

U.S. First Army troops seek German snipers outside a building in St. Vith, Belgium. While Sherman tanks, like the one pictured, were no match for German Tiger tanks, American forces succeeded in overcoming enemy resistance (U.S. Army Signal Corps photo).

PIN: 067526-000

.205
.20
#2

ENGINEERING

Engineer

July 1990

OFESSIONAL BULLETIN FOR ARMY ENGINEERS
arters, Department of the Army

DEPOSITORY
AUG 13 1990
UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

Expanding Our Horizons

PB 5-90-2

Approved for public release; distribution is unlimited.

Sapper and Smoke Make a Perfect Mix

Place chemical companies in engineer battalions? This possibly radical concept has merit—the chemical company must be placed in peacetime where it can best be trained and maintained with a clear battlefield-enhancer focus.

By Lieutenant Colonel Herbert F. Harback

To win on the battlefield requires that a maneuver commander synchronize his forces in a timely manner while remaining attuned to the basic tenets of war. Current command and control doctrine for today's front-line smoke and decontamination (decon) company, however, lacks a knowledge of how to train and maintain this combat-multiplying force for peacetime proficiency and wartime success.

"Where does the smoke soldier and his combat chemical unit fit in?" and "How can the smoke company be best trained to provide a true tactical multiplier to the ground commander?" are timely questions the Army must answer. I believe the answer to both questions is the same.

Schoolhouse View

The chemical schoolhouse at Fort McClellan proposes that the division chemical officer, a nonprimary staff officer located within the bowels of the G-3 section, is to be the higher headquarters of the chemical company. This proposal will not allow a chemical and decontamination company to attain its highest potential as a multiplying force.

"But the assistant division engineer (ADE) calls the shots on engineer assets," some might point out. Not true. The ADE is the assistant to the engineer battalion commander who, as a special staff officer and battalion commander, has a staff and is experienced in providing command and control to his companies.

Although the chemical staff officer is the subject matter expert on technical issues, he is not in a position to provide the daily mentorship and direct coaching needed in the care and welfare of chemical soldiers and their families. Nor can he provide the equipment and training needed by the chemical company. Simply stated, when a chemical company is placed under a staff officer, the unit will never reach its required level of readiness.

Support Approach

A second approach to finding a home for the chemical company is to insert the unit in a supply and service structure. The division support command (DISCOM) has been the most common depository under this concept. At first glance this approach is appealing because DISCOM has well defined command and control assets. But a closer look shows that these assets have a logistical slant and a rear area support outlook. It is a strained affair at best because the two organizations lack a common mission essential task list (METL) training focus.

The chemical company is a task force commander's combat multiplier and must be in a commander's hip pocket with the engineers and the fire support officer. If one believes that as we train (do our daily tasks within a certain structure), so will we fight, then the DISCOM solution offers little long-term gain.

Placing a smoke and decon company in a headquarters command (TDA type) is worse than placing it at DISCOM. This solution is a quick fix that leaves the combat chemical soldiers on the short end in battlefield tactics and wartime focus. Whether within a maintenance or supply battalion, or as a separate unit directly under a support brigade headquarters, the unit will find itself surrounded in a fog of mixed priorities, focus, and concern.

Battlefield Focus Solution

The solution to this dilemma is to properly define the role of the chemical company as an upfront battlefield enhancer. Then, match the company to a similar force that has an onboard staff capable of providing a command environment and training resources. This proposal is tactically sound, and it has been tried and found to be successful in caring for, training, maintaining, and leading combat chemical soldiers.

(Continued on page 29)

Engineer

July 1990

Volume 20 PB 5-90-2

**UNITED STATES ARMY
ENGINEER CENTER AND
FORT LEONARD WOOD**

COMMANDER/COMMANDANT
Major General Daniel R. Schroeder

MANAGING EDITOR
Catherine Eubanks

EATURES EDITOR
Phillip R. Howell, Jr.

RAPHIC DESIGNER
Jennifer C. Bolyard

y Order of the Secretary of the Army:

ARL E. VUONO
eneral, United States Army
hief of Staff

ficial:

LLIAM J. MEEHAN II
igadier General, United States Army

ont cover photo by Sergeant Richard eed, PAO, Panama

FEATURES

4 **After the Storm: Military Engineers and Hurricane Hugo**
by Major Jeffrey R. Sommerville

12 **Beyond the Battlefield—The Other Dimension of Military Service**
by Lieutenant General Henry J. Hatch

20 **French Engineer Alternatives for National Service**
by Colonel Jean-Claude Verite

26 **The Essayons Program: From Brainchild to Drawing Board**
by Chester A. Kojro

30 **Solving the Task Force Engineer Time Crunch**
by Captain Daniel P. McKenrick

38 **A British View on American ADSM**
by Major Alec A. Peebles

46 **Misplaced Compassion**
by Colonel Ron Dabbieri

DEPARTMENTS

Inside Front Cover: **Personal Viewpoint**

2 **Clear the Way**
3 **Bridge the Gap**
24 **Engineer Safety**
29 **Engineer Problem**
36 **Engineer Solution**
51 **Lessons Learned**
53 **Engineer Update**
57 **Past in Review**

ENGINEER (ISSN 0046-19890) is prepared quarterly by the U.S. Army En- er School, ATTN: ATSE-TDM-PB, Fort Leonard Wood, MO 65473-6650. ond Class postage is paid at Fort Leonard Wood, MO, and additional mailing es.

POSTMASTER; Send address changes to ENGINEER, the Professional Bul- for Army Engineers, ATTN: ATSE-TDM-PB, Fort Leonard Wood, MO 65473-).

CORRESPONDENCE, letters to the editor, manuscripts, photographs, official requests to receive copies, and unit address changes should be sent to EN- EER, at the preceding address. Telephone: (314) 563-7762, AV 676-7762.

DISCLAIMER: ENGINEER presents professional information designed to keep y engineers informed of current and emerging developments within their areas of expertise. Views expressed are those of the author and do not necessarily reflect official Army or TRADOC positions, nor does the content change or supersede information in other official Army publications. ENGINEER reserves the right to edit material.

CONTENT is not copyrighted. Material may be reprinted if credit is given to ENGINEER and the author.

OFFICIAL DISTRIBUTION is targeted to all engineer and engineer-related units.

PERSONAL SUBSCRIPTIONS are available by contacting the Superintendent of Documents, ATTN: Chief, Mail List Branch, Stop SSOM, Washington, DC 20402. Address changes for personal subscriptions should also be sent to the Superintendent of Documents.

CLEAR THE WAY

By Major General Daniel R. Schroeder,
Commandant, U.S. Army Engineer School

The past 12 months have seen exciting times at the Engineer Center! The Engineer School move was completed and we have graduated our first engineer officer basic and advance courses at Fort Leonard Wood. We now have all our engineer basic and advance leadership training colocated with our basic training. Now we have the opportunity to do shared training.

In the future, battalion precommand course students will be able to put together a staff made up of advance and basic course officers and advance noncommissioned officer (NCO) course students. When the officer basic course students go to the field to conduct a field training exercise, basic NCO course students and basic trainees can be added to the field unit to build platoons. We will keep you informed on these exciting opportunities.

Contingency operations are going to play an increasingly major role in the way we train and fight in the next decade. In these operations, we will have numerous opportunities to work with our North Atlantic Treaty Organization (NATO) and American, British, Canadian, and Australian (ABCA) partners. Almost everyone knows about our NATO agreements and who the partners are in this European-based organization. Not so with the ABCA agreements and our partnership in this organization. During the coming decade we may well find ourselves operating in this environment.

In the ABCA arena, the armies look at standardization of equipment and doctrine in low- and mid-intensity conflicts. Considering the current world situation, one can surmise that we need to look at this area more closely. Current operations in the ABCA arena show how we are preparing to ensure compatibility.

In March, your Engineer School participated in a project to write a *Strike Operations Handbook* for U.S. Army commanders operating in contingency operations. The draft of this manual should arrive in the field about the same time as this bulletin. It contains excellent guidance on how engineers will fit into these operations.

AirLand Battle-Future (ALB-F) will be based around brigade-sized combined arms task forces, which will be attached to divisional headquarters according to mission, enemy, terrain, troops, and time available (METT-T). In future operations, we may well find ourselves adapting ALB-F to an ABCA multi-nation organization. In some cases, you may find engineer units from other ABCA member nations better organized and equipped to handle the sustainment part of the operation than we are. Therefore, you must be knowledgeable about these units and do a good METT-T, mission analysis, and estimate before task organizing engineers into the ABCA force.

To help you become more knowledgeable about our companies fighting in the corps area, we are writing a field manual titled *Combat Engineer Company Operations*. A coordinating draft of this manual is scheduled for printing in the last quarter of this year.

When we look at the continuum of engineer involvement in the levels of conflict, you see our missions increasing instead of decreasing. Engineers may be on the ground doing nation assistance missions when the situation suddenly intensifies into a low-intensity conflict. These engineers would then clear the way for the maneuver and support troops and units introduced into the battle area. Therefore, we must be well trained on our individual soldier and unit METL tasks to ensure we are ready when the time comes.

We are currently writing a short-of-war field manual to provide guidance in this area; a draft manual is scheduled to be printed in the fourth quarter of 1990.

In the past few years, we have seen contingency forces deployed on exercises such as Golden Pheasant, in Honduras, and most recently, operation Just Cause, in Panama. These joint deployments tested and validated our current doctrine and training. The soldiers performed in a superb manner and engineers were there. Feedback from the soldiers consistently said drills paid off and training at the combat training centers was great preparation. The challenge for each of us is to develop ourselves and our soldiers to be combat engineers trained to standards, who stay ready to deploy on the next contingency operation.

BRIDGE THE GAP

By Command Sergeant Major W. E. Woodall
U.S. Army Engineer School

> *"Our leader development programs are some of the most important ways we maintain the quality force and are also our greatest legacy because they provide the leaders that will shape the Army of tomorrow."*
>
> *General Carl E. Vuono*
> *Chief of Staff, United States Army*
> *2 March 1990*

The noncommissioned officers' (NCO) role in training and caring for our soldiers has not changed, nor s it likely to. Just as they have always been, sergeants are our Army's first-line mentors, coaches, eachers, and role models.

What has changed is the complexity of how these nissions are accomplished. This is primarily due to he tremendous advances in technology and how hose advances have changed the way our Army loes business. Technology has provided our Army vith more deadly weapons, more efficient equipment, etter communications gear, and systems of personnel and supply accountability that were unimaginable vhen many of us were privates. All of these improvements have impacted on how units operate, and they equire today's NCOs to have skills and knowledge hat simply weren't needed in the past.

The words "caring for soldiers" have also taken on new meaning. Not too many years ago, a good portion of many units' soldiers lived in barracks and pent a lot of their free time in mess halls, snack ars, and day rooms. Today, more than half of the rmy's enlisted force are married. The lives of our ingle soldiers have changed. They earn a fair living hese days and can afford cars, TVs, and stereos. oldiers, married and single, are free to come and go s they please in their free time.

As leaders, we must be better attuned to these uman dimensions and understand what these soliers want and need. We need to understand things ke child care, off-duty educational programs, employment opportunities for family members, and other uality of life issues.

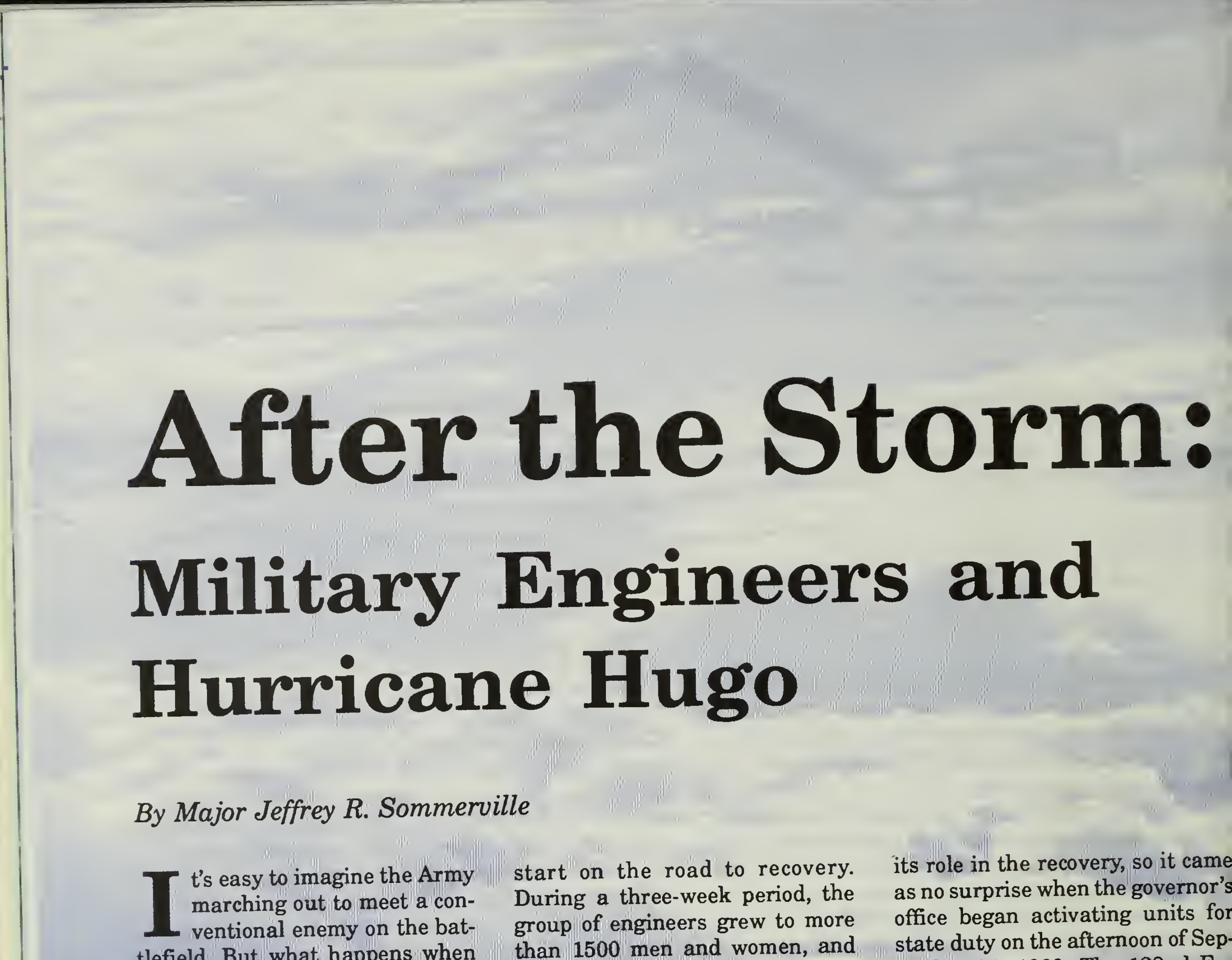
Although a lot of things have changed, NCOs are still charged with the same missions and responsibilities they had in the past. We must still set and enforce standards and provide our young soldiers with the role models many of them are seeking. We need to constantly work for self-improvement and increase our level of education so we can understand, explain, and execute the missions passed on from our commanders.

All of these changes demand that sergeants be proficient in all leadership competencies. We must know and implement FM 22-100, which provides the framework for leader development. The programs this manual outlines provide a broad category of skills, knowledge, and traits necessary for good leadership at all levels. The manual gives us a good yardstick to measure ourselves and our subordinates against. As sergeants major and senior sergeants, we are the key to the professional growth of the NCO Corps, and we must not fail or do the job halfway. Future conflicts and wars will place sergeants in roles more challenging than ever. Sergeants may easily find themselves the sole leader present in many engagements. With little or no guidance, they must be able to take charge, make decisions, take risks, and carry out their commander's intent.

Just as NCOs must continually prepare their soldiers for the demands of war, they must also prepare themselves. Today's sergeants must have a solid understanding of how the Army fights as a total force. Aside from having a handle on modern technology and understanding the enemy, NCOs must understand AirLand Battle doctrine and how their piece of the Army fits into the overall tactical picture.

Today's NCO education system goes a long way toward ensuring that our sergeants are prepared to meet present missions. But, we must change with the times and adapt our schools and training to match the realities of our rapidly changing world. As our missions change during peacetime, so must we.

In many ways we are the masters of our own destinies, and I challenge each of you to keep our NCOs strong and continue to improve the Corps.



After the Storm:

Military Engineers and Hurricane Hugo

By Major Jeffrey R. Sommerville

It's easy to imagine the Army marching out to meet a conventional enemy on the battlefield. But what happens when the enemy is a whirling mass of destruction, immune to bullets and bombs, large enough to be seen from space, and deadly enough to level everything in its path?

When it was clear that Hurricane Hugo was going to hit the East Coast of the U.S. last year, Army engineers went into action while the storm was still 100 miles from land.

Responding to a call from the governor of South Carolina, advance parties of a National Guard corps combat battalion moved into assembly areas west of the expected storm path.

These engineers became the vanguard of a military force that would give South Carolina, hardest hit by the hurricane, a head start on the road to recovery. During a three-week period, the group of engineers grew to more than 1500 men and women, and included members of the South Carolina National Guard and Army Reserve, active duty soldiers from other states, and Corps of Engineers personnel. Working as a team, they played a significant role in helping to put the infrastructure of the storm-stricken area back into operation.

First Call

The people of South Carolina watched closely as Hugo approached, and state officials took a number of precautionary measures to limit potential destruction by the storm. Coastal areas were evacuated, power grids were shut down, and emergency operation centers were activated.

The National Guard anticipated its role in the recovery, so it came as no surprise when the governor's office began activating units for state duty on the afternoon of September 21, 1989. The 122nd Engineer Battalion, a corps combat battalion, and the 125th Engineer Company, a mechanized company organic to a heavy brigade, were the engineer representatives among many Guard units called t duty by the state.

The call from the governor wa in reality a warning order t prepare for area damage contro operations. But at the time of th call-up, little was known of wha lay ahead. Commanders analyze the mission, assumptions wer made, and units task-organize themselves as best they could wit what information they had. No commissioned officers assemble and inspected their soldier vehicles were inspected and dispatched, and equipment wa prepared and loaded for movenent. Radio and television provided the soldiers with the atest information on the path of he storm, and by the afternoon of he 21st, it was predicted that the torm would arrive on the coast bout midnight. Forecasters said he center of the storm would hit omewhere between Myrtle Beach nd the historic city of Charleston.

Advance Parties

As meteorologists firmed up neir estimates of Hugo's speed nd course, plans were made for ne movement of the engineer nits. The 122nd Battalion had asembled at its armories in the estern part of the state, more ian 140 miles from the coast. The attalion was considered far iough inland to be safe, but too stant to allow quick reaction ice the storm had passed. To help eed the 122nd's movement into iarleston, the battalion moved lvance parties closer to the coast. ieir mission was to clear routes storm debris so that the unit's ain body could move quickly to Charleston early Friday orning.

The situation was different for e 125th Engineer Company. eir armory in Bishopville put em 100 miles from Charleston, d 90 miles from the coast at rtle Beach. This position was isidered far enough inland to be e and near enough to the coast afford quick reaction, so they nained at their home station ring the storm. The unit was ected to move to Georgetown, dway between Charleston and rtle Beach, at first light Friday rning.

he meteorologist's predictions the time and place of the rm's landfall were accurate. at they did not foresee was a ricane that would gain in insity as it approached the coast. s additional strength gave the storm a boost that would carry it much farther inland than was expected. The result was severe damage in many inland areas up to and beyond the North Carolina boundary.

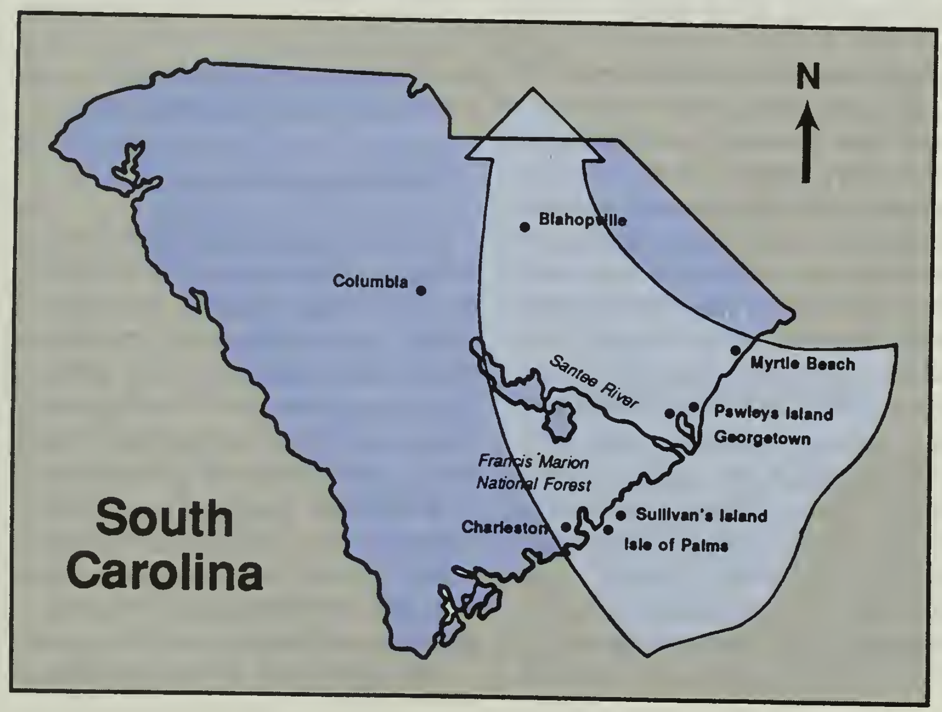
The engineers who moved into the area on the morning of September 22 were among the first witnesses to the destruction of the storm. As the soldiers neared the coast, their rate of march fell drastically as they encountered more and more fallen trees and other debris on the roadways. What would have been a 2-hour trip under normal circumstances became a 6-hour ordeal of clearing trees and removing rubble. Their paths into Charleston and Georgetown provided the first access into the cities for all other emergency and relief vehicles.

Coastal Chaos

On reaching the coast, the soldiers saw destruction caused by a force many times that of the atomic bombs of World War II. Coastal houses were either smashed on their foundations or lifted up and floated away. Power lines were down everywhere, and utility poles listed dangerously out of plumb. Thousands of tons of sand had been moved inland and deposited by the storm tides, completely burying large sections of coastal road. In suburban communities away from the beach, trees were down everywhere, turning neighborhood blocks into massive abatis networks. The Francis Marion National Forest, formerly several hundred square miles of pine forest, was devastated by the storm. From the air, it appeared that some giant scythe had sliced through the forest, leaving the trees neatly on the ground like so many rows of corn.

The first engineers arriving in coastal cities entered areas of mass destruction and confusion. They had arrived before local command and control was established. There was no communications network, the extent of damage was unknown, and work priorities had not been outlined. Cities were without power, water or sewage disposal. And the engineers did not know when their own support would be available, including fuel, rations, maintenance and medical assistance.

But in the midst of this chaos, they quickly made some simple and sound decisions. Two engineer



Commanders from the Reserve and Active Components conducted a joint planning session on the evening of September 26. The meeting resulted in a decision to divide the state into two areas of responsibility for military engineers (U.S. Army photo).

companies made a quick survey of downtown Charleston and saw that just clearing roads was a necessary task that would demand several hundred squad-hours of work. Using a road as a boundary to establish engineer work lines, their platoons went to work clearing lanes through the rubble. Later that day, municipal officials would activate emergency operations centers, and the military would set up their command posts. These operations centers would make adjustments to the division of work and prioritize road clearance. But the decision of the two companies to start work on their own, before receiving specific orders, gave relief operations a big head start.

Military Priorities

South Carolina state officials established three categories of work for the Army, assigned priorities within each category, and—to their credit—wavered very little from those priorities. The first and highest priority was to clear trees from power lines and open access to powerline rights-of-way. Next came the opening of roads, with an initial single-lane clearing, and then the entire roadway. The third priority was debris removal.

The governor's policy was that military units would work only on powerlines and roads, and that debris removal would be done by contract labor. Ironically, there were many times when it was necessary for the military to haul storm debris in order to accomplish their main missions. There were places, particularly in downtown Charleston, where the downed trees were so thick that crews had to haul away debris just to have room to work.

The 122nd Battalion coped with the problem by organizing day and night work shifts. The day crews would cut and stack and the night crews would load, haul and dump. This allowed them to use their equipment around the clock, while restricting the most dangerous work (chainsaw operations) to daylight hours.

The state assigned work to the military through its county emergency operations centers (EOCs). To draw a parallel with the Army's command/support terminology, the engineer units were attached to the state and put in direct support of a county. The state retained command of the units through the office of the Adjutant General. The state was responsible for their logistics support and allocated engineer companies to counties. Counties received support based on the availability of units, a declaration of the county as a disaster area, and a request for help from the county. Once allocated to a county, an engineer unit received its tasks and priorities from the county EOC.

The system ran smoothly as long as counties assigned work from the state-mandated categories I and II. Understandably, there was a temptation to assign engineers debris removal (category III) work, and the counties made many such requests. In most cases, these had to be disapproved by the engineers. The lack of a clear understanding by local officials of the state-intended role of

ne Army engineers occasionally
aused friction between the mili-
ary and local civilian authorities.

Reinforcements Arrive

Hugo had sustained high winds
l the way across the state, caus-
g destruction over a wide area.
onsequently, it took a long time
r assessment teams to deter-
ine the extent of storm damage.
n Monday, September 25, the
vernor decided to ask for help
om the active Army. His request
as made that evening, and with-
a matter of hours warning or-
rs were being received by active
ty engineer units in Georgia.

The 3rd Engineer Combat Bat-
lion and the 92nd Engineer
mbat Battalion (Heavy) from
rt Stewart, and the 43rd En-
neer Combat Battalion (Heavy)
om Fort Benning, underwent
nergency deployment proce-
res the following morning. In
dition to the line units, Fort
ewart sent its Victory Brigade,
ade up of combat support and
mbat service support units, into
e state to support the engineers.

The response of the active units
s so rapid that they were able to
rt their movement east toward
arleston before the state plan-
rs knew where they wanted to
t them. As a result, some units
gan moving before their des-
ations were known.

Tuesday evening a joint plan-
g session between Active and
serve Component commanders
s convened in Charleston. And
e again, an engineer work line
s used to give units their initial
a objectives. In this case, the
ntee River was used to divide
eastern half of the state into
sections, Area of Operations
O) North, and A/O South. A/O
ith would remain the work area
the 122nd Engineer Battalion,
ile A/O North became the
ponsibility of the active units
l the 125th Engineer Company. County boundaries continued to be used to subdivide the state into company-sized areas of operation.

Inland Recon

There was a major difference between the engineer work effort on the coast and that further inland. In contrast to the widespread destruction along the coast, damage to the inland counties was sporadic. As a result, units assigned to the interior of the state had to devote a great deal of their energy to reconnaissance. Again, to relate the situation in military terms, the inland work was not a great expanse of abatis, with single worksites that could swallow up a platoon-week. Instead, it was an indiscriminate series of point obstacles, spread over hundreds of square miles. A squad could work for an hour or two in one place and finish the job, and then need a frag order to tell the location of the next work site.

Because of the reconnaissance requirement, engineers working the inland counties had a problem keeping their platoons busy. Other factors complicated their ability to work on storm damage. Powerlines could not be cleared until the area was declared safe for work crews. Unfortunately, the power companies did not have the manpower to escort engineer platoons to the various work sites in each county. The goal of power officials was to have every available lineman busy rehanging electric lines, and they were hard pressed to pull employees out to have them check lines. This constraint was another major difference between the coastal and inland work areas. The crews on the coast did not have to worry about hot lines because power had been shut off in their areas before the storm reached the coast.

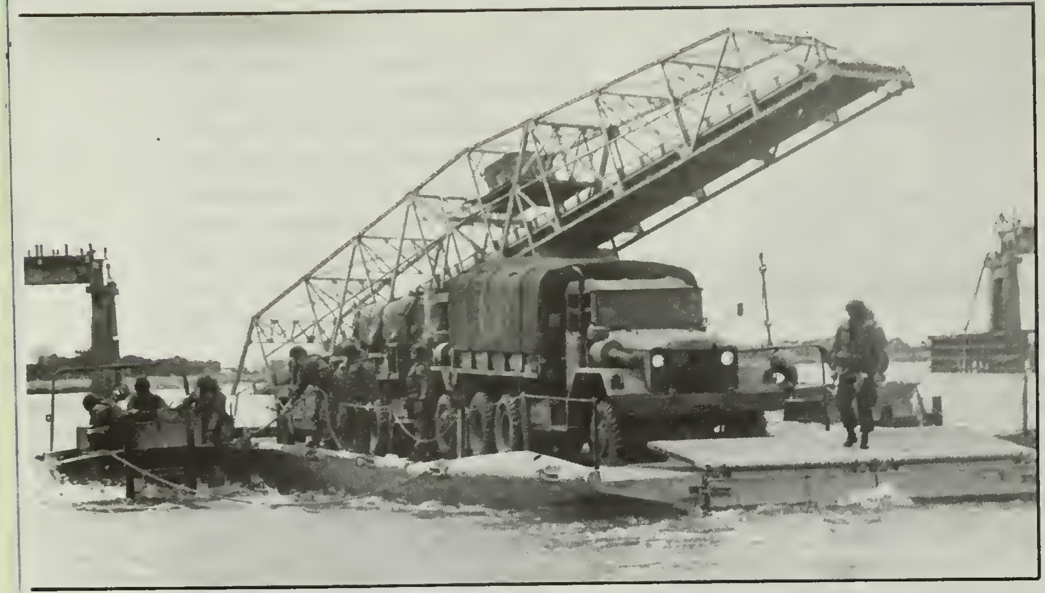
As work progressed, it became necessary to develop a procedure for determining when the military effort in a particular county had been completed. This was especially important in A/O North, where platoons often sat idle because of delays in the reconnaissance process. Company commanders wanted to either get their platoons working or move them on to another county, but they had no authority to leave.

The Guard had activated two brigade-level headquarters, one in A/O North and the other in A/O South. These headquarters were responsible for allocating and monitoring engineer units among the counties in their area. They did not want to move a unit out of a county without assurance that all road clearing and powerline work had been completed. But, they had no way of knowing if the work had been completed without being notified by the county director.

Predictably, the directors acted very much like an infantry task force S-3 would react if asked if he would mind giving up a direct support engineer platoon. Directors were usually reluctant to give up an asset, even if powerline work appeared to have been completed. It was especially difficult for them to approve the release of military engineer support while significant amounts of storm debris remained piled along roads. And it was a rare county director who approved a release without attempting to get at least some debris removal work done. But state officials stuck to the established priorities, and every time a county requested exemption from the state priorities, the request was denied.

Special Problems

There were several sites along the coast where the category II work of clearing and opening routes entailed tasks of a different nature than simply cutting and clearing windfall trees. The combination of wind, waves and tide had caused tremendous erosion in



Soldiers from E Company, 3rd Engineer Combat Battalion, an Active Component unit from Fort Stewart, use a ribbon bridge ferry to take South Carolina National Guard troops to Sullivan's Island. Hugo had put the Ben Sawyer Bridge, in the background, out of commission (Photo by Jonas Jordan).

some coastal areas. In one instance, a steel highway bridge had been removed from its abutments.

The south end of Pawleys Island is not much more than a large, narrow sandbar high enough to stay dry during most high tides. But it was also home to several families. Besides destroying many of the homes on the island, the storm had played a particularly troublesome trick on the islanders. It had cut the island in half. As waters from the initial storm surge receded back across the island, a section of the island's asphalt road was washed out. The water then tore away a chunk of the island itself, undermining and overturning a house. After the surge retreated, there was a breach in the island about 10 feet deep and 30 feet wide. Depending on the tide, water flowed through this breach at a rate of several hundred to several thousand cubic feet per second.

Initially, it was thought that a bridge, culvert or cofferdam would be needed to close the breach, but the decision was made to try and plug the gap with sand. The 122nd Battalion was given the task. Two early attempts ended in failure as the heavy tide flow quickly erased any evidence that men and machines had been at work. The engineers marshalled their resolve and resources. Brick and stone rubble were piled next to the breach. This would be used later to form an erosion-resistant base at the bottom of the gap. A full day was also spent stockpiling sand on the shoulders of the breach. When low tide arrived, they were ready for their third assault on the island breach.

Dozers working both sides of the breach first pushed in the rubble. Then the stockpiled sand was dozed into the breach as fast as the engineers could move it. The engineers worked their bulldozers continuously for 6 hours. Their dump trucks were kept running the length of the island, feeding more and more sand to the dozers. When the next high tide arrived, the engineers' hard-fought repair work held back the water and the island was joined together again.

The Island Ferry

The Isle of Palms and Sullivan's Island, two other coastal residential areas, were also isolated by the work of Hugo. Both islands had been connected to the Charleston suburb of Mt. Pleasant by the Ben Sawyer Bridge. The bridge was designed to allow ships through the navigation channel by rotating on a pedestal in the middle of the channel. Hugo had dislodged the abutments, rotated the bridge, then tipped the superstructure so that it slipped from its bearing on the center pedestal. One end of the bridge ended up in the channel, and the other end pointed skyward. The two islands serviced by the bridge faced long-term isolation and a bleak future.

The islanders' plight was answered by E Company, a bridge unit from the 3rd Engineer Combat Battalion at Fort Stewart. The company had arrived in Charleston the day after the governor's call for Active Component assistance, and was task organized under the 122nd Battalion.

After surveying the area, Echo Company leaders found that a launch ramp near the base of the Ben Sawyer Bridge provided an excellent access point. However the lack of a suitable abutment on the island side of the channel precluded construction of a bridge. An egress point was located further north on the island, and Echo Company soon had a ribbon bridge ferry in operation. The determination of who could use the ferry was handled by municipal authorities. This left the soldiers free to operate the raft and contend with the problems of crossing non-tactical vehicles on ribbon bridge equipment.

The Corps

While soldiers of the Active and Reserve Components were working in the media spotlight, the third leg of the engineer triad was busy at work behind the scenes. The Charleston District of the Army Corps of Engineers played several key roles in the disaster relief operation, although very few of South Carolina's citizens were aware of their relief efforts. Much of their work was done from inside buildings and over the telephone, but they also performed duties on the highways and waterways.

One of the Corps' first tasks was to activate and dispatch damage survey teams to inspect areas hit by the storm. These teams formed part of the federal government's reconnaissance effort that would lead to the declaration of federal disaster areas within the state. These teams included electrical engineers, who assessed the power supply damage, and structural engineers, who looked for damage to bridges. They also surveyed the problem of debris removal, providing a state-wide picture of the significant trash disposal problem.

Contract negotiation was a critical and time-sensitive part of the Corps' relief contribution. While work was still being done to clear roads and restore power, a warning went out that an exceptionally high tide was due to arrive. The tide was expected to cause extensive damage in many coastal areas, unless artificial barriers could be constructed. With no time to waste, the Charleston District contracted with civilian companies for the construction of artificial dunes in the most vulnerable areas. Within a matter of days, the contract equipment was on site and piling sand. When the high tide arrived, the dunes were already in place, and the coast was protected.

Perhaps the most visible work by the Charleston District was the restoration of the Ben Sawyer Bridge. District crews used barges, tugs and a crane to lift the bridge back onto its pedestal and realign it with its abutments. Two barges were positioned to serve as floating abutments, and steel bents were constructed on the barges. A third barge was used to support a crane. The crane lifted the low end of the bridge, allowing the superstructure to be placed onto the two floating abutments. The tugs were then used to maneuver the floating abutments until the bridge was realigned with the approaches. Although unable to rotate on its center pedestal, the bridge was back in operation within two weeks of the storm.

Stand Down

Deactivation of Guard units and release of the Active Component soldiers began during the second week of recovery. The first unit released was the 125th Engineer Company, the Guard unit from Bishopville. The unit was faced with a situation unique among all of the Army units assisting the relief efforts, and it was felt they deserved an early release.

The 125th had been activated on September 21, just before the storm, and spent the night at their armory. At the time those orders were issued, it was believed that their home station of Bishopville and surrounding Lee County would not be significantly affected by the storm. But when they departed Bishopville the next morning, they left behind heavily damaged homes and property, and families that were stranded without power.

Several days later, Lee County was added to the list of counties that were federal disaster areas, and on September 27, a company from the 43rd Engineer Battalion was assigned to Lee County to perform category I and II missions.

The men of the 125th had left their homes without knowing whether their families were safe and their property secure. They went to work in neighboring communities to help fellow citizens, who in some respects were better off than their own families. But these soldiers followed their orders and made a personal sacrifice not often seen in a peacetime Army.

By the end of the first week of October, all road and powerline work in the state had been completed, and units were either on their way home or planning to leave soon. All components of the Army had responded quickly to the emergency, and had worked together well to restore order to the stricken communities.

Looking back at those few weeks of work in the wake of Hugo, a young training NCO from the South Carolina National Guard said, "This was the most real thing we have ever done...we cut our way into this city and found out there was...no power, no water, no toilets, nothing. And nobody knew what was going on. The chaos and confusion that existed in this place during those first couple of days has got to be the closest we'll ever get to battlefield conditions....But we got organized, we got busy, we got to work...and we got things done."

The men and women engineers who answered the call for help in the wake of Hurricane Hugo had worked selflessly to aid their own countrymen. And not only did they make a difference in the lives of thousands of fellow Americans, they gained experience that made them better soldiers.

Major Sommerville is the Engineer Team Chief, Readiness Group, Fort Jackson, South Carolina. He previously served as a project manager for the Louiseville District of the Corps of Engineers. His other assignments include company commander, assistant S-3, and assistant division engineer in the 9th Infantry Division. Major Sommerville is a West Point graduate, and holds a masters degree in civil engineering from Washington State University.

The Hugo Notebook:

Lessons from a Hurricane

Problem: *Availability of Maps*

Discussion: The engineer relief effort was slowed because of a shortage of maps. Additionally, the maps that were available did not provide the detail needed to support engineer relief operations.

Recommendation: Each county should establish a supply of large-scale maps which can be given to relief organizations. An engineer company needs about 30 maps. The ideal county map would show all roads, location of all powerlines, and have an overprint of the UTM grid system. The ideal urban map, for towns with populations over 10,000, would show all streets and roads by name. Each map would also show the location of all government buildings, including schools, armories, fire stations, court houses, etc. A map showing the entire power distribution network (minus the drops to individual buildings) would be helpful for all engineer headquarters, from company level on up.

Problem: *Combat engineer companies did not have enough chain saws to support the requirement for clearing roads and power lines.*

Discussion: Engineer companies have nine chain saws, one per engineer squad; one pneumatic saw; and one hydraulic saw with each Small Emplacement Excavator (SEE). There were not enough organic saws to keep the squads busy, and when saws had to be pulled off-line for maintenance, the problem became more acute. Fortunately, many privately owned saws were loaned to the engineers by local individuals and organizations.

Recommendation: For such intense relief work, provide one chain saw for every four workers, with an additional 30 percent maintenance float.

Problem: *Utilities companies were not able to identify work requirements fast enough to keep engineer units fully employed.*

Discussion: Engineer units were initially allocated at one company per county in the inland counties. Storm damage in these areas was sporadic, with many small areas of downed trees throughout affected counties. Often these areas required only a few squad hours to clear, leaving th squad free for a new mission in another area. However, utilities personnel were unable to identify work areas quickly enough to keep the engineers moving from site to site without delay. Delays in determining whether downed powerlines were "hot" also caused undue delays in relief work.

Recommendation: The work output of engineer units can be considerable, but they can be fully utilized only when jobs are available. While utilities companies are understandably strapped for personnel during such weather emergencies, an ideal arrangement would be to place a utilities representative with each engineer platoon. The representative should be equipped with a four-wheel-drive vehicle, a portable telephone, a large-scale map of the area, and the ability to determin if powerlines are hot.

Problem: *Private and commercial vehicles required special consideration for access and egress from ribbon bridge ramps.*

Discussion: Private and commercial vehicles often do not have sufficient power, traction or road clearance to load and off-load from a ribbon bridge. The steeper the slope of the ramp, the fewer non-military vehicles that can use it.

Recommendation: When a ribbon bridge is to be used by civilian vehicles, access and egress ramps should slope as gently as the ramp bay wi allow.

Problem: *State-mandated work priorities for Army engineers were not fully understood by local civil authorities.*

Discussion: Early in the relief effort, the governor established priorities for engineer work. The priorities were well understood within the military community, and they did not change throughout most of the relief effort. However, there was a need to constantly reemphasize and restate those priorities to county officials who directed the engineer work. When work was requested that fell outside of the governor's guidelines, it was denied by the engineers. Unfortunately, this caused some unnecessary friction between civil and military personnel.

Recommendation: To avoid misunderstandings, the state should ensure that local officials are fully informed of the governor's instructions for the use of Army engineer assets.

Problem: *Congested roads in urban areas significantly slowed engineer relief efforts.*

Discussion: During the first several days after the hurricane, the city of Charleston remained open and relatively free of traffic. The lack of significant private or commercial traffic allowed engineer units to move freely among work sites. However, the situation changed drastically after the first few days. The roads became choked with returning property owners, commercial vehicles, and sightseers. With the roads only partially cleared of debris and traffic lights still out of operation, traffic in parts of the city reached gridlock.

Recommendation: Civil authorities should restrict access to urban areas as much as possible until roads are cleared and traffic lights operational. Also, traffic control units, military or civilian, are needed to ensure that the relief work of engineer units is not hindered by traffic snarls. If possible, some routes should be dedicated to military and relief vehicles.

Problem: *Units did not perform route reconnaissance before sending company convoys into the storm damaged areas.*

Discussion: Engineer companies were sent into damaged areas in the early morning of September 22, only hours after the storm had passed. Company convoys were put on the road without the benefit of either ground or aerial reconnaissance of the route. The convoys were frequently stopped by trees that blocked the roads. Movements that could have been completed in less than 2 hours on open roads took upwards of 6 hours because of downed trees.

Recommendation: A squad of engineers in a HMMWV, with a supporting SEE, bucket loader or backhoe, should be sent out as a point team to clear roads ahead of the convoy.

Issue: *Identification of storm damage categories and engineer work requirements.*

Discussion: During the relief effort, military engineers were used to perform the following tasks:

a. *Clearance of trees.* Clearing roads and powerlines of downed trees was the most common storm damage encountered by Army engineers.

b. *Rubble on streets.* Rubble, primarily roofing material, blocked many roads. Initial clearing efforts consisted of pushing most debris to the sides of the roads. In some areas, there was so much debris that it was necessary to haul it away. Salvageable property, such as private vehicles or even entire houses, sometimes blocked roads.

c. *Sand deposits on roads.* Roads in beach areas were buried under sand up to several feet deep.

d. *Erosion breaches around bridges and culverts.* Roadways were destroyed and hundreds of cubic feet of roadbed material were washed away by waves and subsequent tidal action.

e. *Landfill operations.* As landfills became full, it was necessary to use Army bulldozers to keep the landfills open.

Recommendation: Military engineers with hurricane-related area damage-control missions can use this list of damage categories for their initial operations planning.

Issue: *Use of the Small Emplacement Excavator (SEE) during relief operations.*

Discussion: Engineer units of the South Carolina National Guard used their recently issued SEEs during the Hurricane Hugo relief effort. The SEEs were found to be very reliable and well suited to the mission. The vehicle's high mobility allowed it to keep up with engineer work teams moving in HMMWVs and dump trucks. It had sufficient power to push and/or lift tree trunks that blocked roadways. The hydraulic chain saw was used extensively. It was found to be lightweight, easy to use, reliable, and powerful. In some cases, the bucket of the SEE was used to provide an elevated work platform for engineers who were clearing tree limbs from power lines.

Recommendation: None.

Beyond the Battlefield -

The Other Dimension of Military Service

1989 Kermit Roosevelt Lecture given by
Lieutenant General Henry J. Hatch,
Chief of Engineers

Recently, General Carl Vuono, Chief of Staff of the United States Army, wrote an article for the Armed Forces Journal. In that article General Vuono said, "The U.S. Army, like the nation's intercontinental nuclear force, is a strategic force. The Army is an essential element in the execution of national military strategy which aims to deter conflict at all levels, and if necessary, to fight and terminate wars under favorable conditions."

The thesis of my presentation is that if the Army is to be fully effective in carrying out this vital strategic role, it must be capable of projecting power to the point of influence in its peacetime operations as well. In addition, to be successful in this regard, the leaders and planners of the Army must engage in strategic thinking, and must institutionalize a process for sound long-range planning.

From my perspective, the concept of a strategic force involves two dimensions. The first of these is familiar and is usually the focus of discussion among defense strategists and national security analysts. The Army must be prepared to win on the battlefield. Forces must be organized, trained, equipped, and positioned to deter and—if necessary—successfully wage war. In other words, the Army must be prepared for war fighting.

The "other" dimension of military and strategic service is less familiar. The Army must be prepared to address a broad range of national security concerns during peacetime. It, more than any other service, must step up to the role as the nation's general military servant. This role requires the Army to carry out a range of tasks beyond the battlefield—to prevent war—to manage peace—to undertake the nation's most difficult and tedious tasks. Soldiers fighting forest fires in the American west and engineer units building roads in Central America are just two contemporary examples of these tasks.

The concept of a strategic force implies more than reacting to requirements as they develop. A strategic force must actively anticipate needs, and position organizations and resources to meet these needs. It must think and plan strategically. The Army must not only be willing to perform dirty and difficult jobs in the nation's service, it must do them well. This "other" dimension of a strategic force is not a secondary role. It was central to the development of the United States. It is important today; it is an imperative for tomorrow.

Thus, it is my intention to expand on the concept of the Army as a strategic force by focusing on this "other" dimension. Along the way, I will briefly review the U.S. Army's service to our nation in an historical context, and then discuss some of the changes taking place on the international scene—the external influences. Finally, I will address strategic thinking and planning, and sketch out some possibilities for the Army's future—beyond the battlefield.

Historical Context

The histories of the United States and its Army are inextricably linked. For much of he 213-year history of our na-ion, the Army has indeed been the loyal military servant, and it has undertaken a variety of tasks—international and domestic. Before we turn our attention to the Army's historical roles as a general military servant, however, I reiterate that our basic business as soldiers is to serve the nation well on the battlefield.

The history of the American Army in combat—as this audience well knows—pre-dates the founding of the United States. The fledgling Continental Army had to immediately engage a well trained, seasoned, highly professional force in a war for American independence. I can't help but note with some pride, as the Chief of Engineers, that from the outset combat engineers played a pivotal role in that conflict. For example, General George Washington selected Colonel Richard Gridley to serve as the first Chief Engineer of the Continental Army, and immediately put him to work preparing defensive fortifications on the high ground overlooking Boston.

These fortifications were needed to prepare for an imminent attack from British regulars. That attack came on June 17, 1775, and the colonials held firm behind the hastily constructed earthworks. This action, known as the Battle of Bunker Hill, demonstrated the importance of combat engineering to the Continental Army, and foreshadowed the significant contributions that were to come.

General Washington recognized that his poorly trained, ill-equipped troops needed every tactical advantage they could gain against their superbly trained adversary. Sappers of the Continental Army played an equally important part in the last campaign of the War for Independence, the siege of Yorktown. Here, their abilities to support offensive operations were tested as they sought to breach British defenses. The engineers were successful, and ultimately the combined efforts of American and French ground forces and the French fleet brought about the termination of the conflict on favorable terms—at least from an American perspective.

From these beginnings emerged a tradition of an Army that always served the nation well in war time. This tradition continued through the 19th and 20th centuries to the most cataclysmic conflict in the history of warfare, the Second

The hastily constructed fortifications on Charleston Heights overlooking Boston, during the Revolutionary War, proved the value of engineers to the Continental Army. This illustration is viewed from behind the patriot lines.

World War. The many engagements of World War II provide examples of some of the most remarkable feats of arms for both the British and American armies as they fought shoulder to shoulder.

At the risk of sounding too parochial, I will cite one example which highlights combat engineers fighting as infantry but which also illustrates those qualities which are essential to success on the battlefield—sound leadership, initiative, tenacity, and courage.

In December of 1944, the Germans launched a final, desperate offensive through the Ardennes. This armored thrust caught the American 99th and 28th Divisions completely by surprise, and their lines were quickly breached. As the German armor rolled forward, at least two engineer units, the 291st and 51st Battalions, were forced to shift quickly from cutting timber and graveling roads to fighting tanks. In the confusion, officers gave orders to sergeants with whom they had little prior contact, and those sergeants led motley collections of soldiers from various units. Acting in small groups to erect road blocks, hold key road junctions, and do whatever had to be done, these men stood fast.

In the end, the initiative and independent actions of junior officers and noncommissioned officers blunted one of the key spearheads of the German attack, and allowed other units to get into position. I might add that this action, known to Americans as the Battle of the Bulge, is also an excellent example of cooperation between our two armies as control of American forces north of the German penetration was passed smoothly to Field Marshall Montgomery.

In sum, the history of our Army includes numerous chapters which were written on the battlefield. The colors of the United States Army are decorated with 168 battle streamers, and I have no doubt that more will be earned.

However, there is another dimension to this history. For two centuries the Army has carried out a broad range of tasks in service to the nation. For example, the Army contributed to the opening of the continent, development of the engineering profession in America, and construction of transportation networks. These contributions beyond the battlefield are in many ways as important as the Army's primary peacetime role of preparing for war.

In the early 19th century, the nation sent explorers such as Captain Meriwether Lewis and Lieutenant William Clark to open unchartered territories in the west. From 1804 to 1806, these two officers led an expedition to the headwaters of the Missouri River, across the Continental Divide to the Pacific Ocean, and back. Their expedition covered some 7600 miles by boat, on horseback, and by foot. They brought back the first primitive charts of the area, and collected botanical and zoological specimens. This expedition, together with the efforts of other Army explorers, transformed the west from a great unknown into a territory which captured the imagination of the American people.

A second area in which the Army made a major contribution was in the development of the engineering profession in the United States. In March of 1802, the United States Army Corps of Engineers and the U.S. Military Academy at West Point were established by the same act of Congress. This act began a lasting association not only between these two institutions, but between the Army's military engineers and the civil engineering profession.

I might digress to note that we owe a debt of gratitude to the British army for the concept of the military academy. Your army was the first to recognize the importance of higher technical education for military officers. As a result, the military academy at Woolwich for engineering and artillery studies was established in 1721. West Point was established as the first engineering school in the United States in response to the demands of a growing nation for trained scientists and engineers.

Military engineers at the academy adapted European engineering theory to the practical applications required by a growing America. This combination produced an engineering curriculum and trained engineers that served as the foundation for all engineering education in the country. Graduates of West Point surveyed, designed, and built roads, canals, and railroads throughout the United States.

The legacy of this early relationship between military engineers and the engineering profession remains alive as my command, the U.S. Army Corps of Engineers, is responsible for a host of civil functions, including flood control and management of navigable waterways.

Thus, in the broad sweep of history, the contributions of the Army to the United States have gone far beyond the battlefield. However, in recent decades we have been more focused on war and preparing for it.

The Cold War

For the past 40 years the U.S. focus on national security has been the rivalry between the United States and the Soviet Union. This rivalry, with its military, economic, and ideological dimensions, has dominated the national security agenda for government officials,

soldiers, and the American public. The United States was perceived to be in a life-or-death struggle with an extremely powerful and dangerous adversary. The Soviet Union was seen to be steadily extending its reach, and the communist states were seen as a monolithic block.

The defense of our allies, particularly those in Europe, was the highest priority, but this strategic competition was carried on in the less developed nations as well. The centerpieces of national security strategy were the nuclear deterrent, large standing forces, and forward deployment of substantial portions of these forces. The imminence of the Soviet threat was widely accepted by the American public and our allies.

Changing International Environment

However, during the last two decades, trends have emerged which have begun to change the nature of the international system and the nature of the threat. Although I believe that the United States remains ahead as an economic and military superpower, its lead along both of these dimensions has diminished. The nations of Western Europe—including the United Kingdom—and Japan have fully recovered from the Second World War and are major economic powers. The industrial democracies look to each other as both trading partners and economic competitors.

Economics and military power have become further diffused in what used to be called the Third World. Many of these developing nations have become significant industrial powers and have acquired quantities of modern armaments. Many nations and even sub-national groups can now pose military threats—at least on a regional basis.

Meanwhile, the perception of the Second World has changed sharply. Differences and disputes

The forward deployment of forces was a centerpiece of our national security. The stationing of Army units in Europe, like these engineer and armor soldiers, was widely accepted by the American public as a deterent against the Soviet threat (Photo by Specialist Bob Bastedo).

The degradation of our environment has evolved into a major factor of global significance. The Army's Toxic and Hazardous Materials Agency recently completed on-site treatment of 1,138 drums of dioxin and herbicide-contaminated soil and other materials by incineration (U.S. Army photo).

among the so-called socialist states have shattered the images of a communist bloc. The communist model of economic development—autarky and tight central control—has been widely discredited. The economic progress achieved by the Soviet Union in the years immediately after the Second World War was selective and could not keep pace with the rest of the world. Virtually all of the communist countries are looking toward some type of market mechanism to overcome gross inefficiencies in their economies, and are simultaneously struggling with the implications of the attendant loss of political control.

Other changes have taken place in the international environment. It has become increasingly difficult, especially for the major powers, to convert military resources into usable political power. Rapid and widespread communication has made it more difficult for governments to control internal debate on the causes and conduct of war. The superpowers are constrained in their use of force by the risk of direct confrontation with each other. Several conflicts have demonstrated the potency of nationalism as a motivating force. Lesser developed countries and sub-national groups have used terrorism and irregular warfare to achieve their objectives.

These factors have served to raise the costs and reduce the benefits of the direct application of military force. These changes are beginning to have a profound effect on the very meaning of national security. It warrants continued re-definition.

Direct conflict with the Soviet Union has been made less likely, and more costly should it occur. This point underscores the concept that henceforth the principal function of military forces will be to deter—not wage—war. Of course, preparing to prevail in any conflict remains a central element of deterrence, but the focus is somewhat different. The principal functions of military forces become preventing and limiting conflict, and projecting power to the point of influence in a world at peace to manage threats to that peace.

The limits on direct use of military power and the problems which the Soviet Union must confront serve to lessen the perception of a Soviet threat..., and in democracies the public is quick (perhaps too quick) to accept good news. I note as an aside that Mr. Gorbachev knows this too well. His initiatives have time and again generated pressures for reduced defense spending—reductions which are premature at best for a force that must be responsive to an enemy's capabilities, not words.

Future threats to national security will increasingly emanate from economic and demographic issues in addition to political or ideological differences.

And, finally, there is at least one more trend that has evolved into a major factor of global significance. That is the degradation of the environment itself—everything from climate change to nuclear waste to ocean dumping to the destruction of jungles and wetlands, to name a few. I can assure you that the destruction of our global environment and its rapid impact on all species of life, including man, is certainly a national security issue. The questions for the Army are the degree of threat and what the Army's response should be.

Requirements Across the Strategic Continuum

Today our Army is oriented on a war-fighting spectrum from low intensity conflict to general war, with the primary focus on deterring the latter while recognizing the higher probability of the former. If the low intensity conflict is more likely, should we not move beyond the end of our conflict spectrum and conduct peacetime military operations that will deter at that end as well?

No longer can security be considered narrowly in the context of the U.S.-Soviet rivalry, with its focus on military power. The national security objectives of the United States now include references to meeting the challenges of a global economy, and efforts to address the root causes of regional instabilities. The result is a much broader view of national security.

The view of national security that has been dominant until now has led the Army to concentrate on tasks associated with war fighting. Army leadership has focused—quite properly—on fielding a well trained, well equipped force that was prepared to win the AirLand Battle in Europe.

The Army has been structured around a strategic concept that calls for sizable forward-deployed forces that could rapidly be reinforced. Virtually the entire Army, both Active and Reserve Components, is geared to this task. I hasten to note that one exception is the recent addition of light infantry divisions to the force. These divisions have added flexibility and diversity to the Army's ability to respond.

Now the Army is at a turning point. The tough thing about a turning point is that you cannot see around the corner. The future cannot be illuminated directly (without some mirrors). Only a keen imagination can improve our vision and illuminate alternatives.

In view of the changes evident in the international system, the future may well bring a reduction in forward-deployed forces and a commensurate reduction in the size of the Army overall. This is particularly true if the Army continues to define its mission and corporate identity in terms that are seen to be less relevant to the national security environment of the future. Thus, if the Army is to continue to serve the nation well, it needs to (again) diversify beyond war fighting.

The Army must step up to the task of projecting power to the point of influence in order to counter peacetime threats to our national security interests. This may or may not be on the battlefield. In fact, I question whether the paradigm of the battlefield has continued validity as the Army's sole strategic organizing concept. As a tactical concept, yes; as a concept to train young soldiers and their leaders, yes; but the future role of the Army—its vision of service into the next century—must go beyond the notion of the battlefield.

Implications for the Future

The relationship between our two nations, the United Kingdom and the United States, is one that carries a rich history. It is a relationship based on shared values and a common political heritage. Today and in the future, the interests of our nations will continue to transcend the mere physical defense of our homelands.

These interests will be based on the maintenance of a degree of global stability which preserves our values. Broadly stated, U.S. national interests include the survival of the United States as a free and independent nation with its fundamental values intact, its economy healthy, its environment sound, its institutions and people secure. A second component of these security interests is a stable international system that promotes human freedom and dignity, a sound global environment, and a fair and open economic system.

To be a strategic force in service to these national security interests, the Army must project power across the entire range of the operations continuum. We must be prepared to wage and win a general war, and we must also be prepared to contain peacetime threats such as terrorism and low intensity conflict.

What are some of the new paradigms of projecting power in this context? It goes beyond the threat or presence of combat forces. It will mean influencing people, institutions, and events through infrastructure development, medical assistance, communications, and training. It will mean developing judiciary and financial institutions. In other words, projecting power will mean reflecting to the world our way of life, our economic system, our form of government, and their intrinsic value. This is the elegant use of power to influence and stabilize. It will be those stabilized countries that will lessen the risk of conflict and, thus, enhance peaceful coexistence.

Projecting power to the point of influence through our peacetime operations is indeed managing the peace. Asking the Army of today to increase its emphasis on this dimension of military service—managing the peace—requires strategic thinking and long-range planning by its senior leaders. The reference points for this kind of thinking are not usually found in today's in-box. Simply extrapolating from the threats and responses from the past and present to 20 or 30 years out will not work. It's like trying to illuminate a playing field with a laser beam.

> *". . . the Army has the strength to prevail on the AirLand Battlefield, and it (can) influence the management of peace on a restless planet."*

What is needed is a floodlight—perhaps several floodlights shining from different positions and at different angles. Sometimes thinking strategically about the world three decades from now requires us to leap out and consider the broad picture. We cannot predict the specifics, but we can consider the trends, evaluate alternative scenarios, and consider the enduring basics.

Let me give you one example. Our Chief of Staff says that one of his principal priorities is maintaining a quality force. I think we could agree that whatever our armies will do in the year 2020, they will want a team of quality players to do it. I haven't said anything about forward deployed forces, or how they are armed, or whether they will be using laser weapons, and so on. Regardless of those concerns, we will want a force capable of responding to its mission. That means we must attract, motivate, and retain an effective and productive force.

And what does that mean? From my perspective, one of the things it means is that we must look carefully at the quality of life for our soldiers on our installations. We need to consider issues like housing, child care, and facility maintenance. I suggest that this realm of a quality force is one that should be illuminated with strategic floodlights. A broad range of alternative scenarios should be considered, and then this analysis should be brought back to today...to position ourselves for the future. Mere extrapolation will not work.

Now, let's turn on those floodlights to illuminate another of the possibilities for the future. The political and economic instability of the developing world poses a clear threat to western interests. Part of the response to this threat is to attack the roots of this instability—grinding poverty, ignorance, and inadequate and uneven economic development.

What is required is a process of nation building. In many instances, Third World countries lack the most basic facilities for health care, and have poor transportation and communication networks. In fact, the United Kingdom, the United States, and virtually all of the developed nations have directed substantial sums of developmental assistance to alleviate these problems.

I suggest that the U.S. Army, principally though the use of support units, can lend assistance in this area. This assistance can range from the construction and management of major projects, perhaps entire cities, to the provision of advice on the construction of wells, to visits fro medical teams. However, these activities must be undertake within the broadest context of ou own foreign policy objectives, an with sensitivity to the culture o the host nation.

An example of this type of assistance is presently underway in Central America. There, Army engineers from our Active and Reserve Components and civilians from my own command are engaged in projects ranging from construction of roads and airfields to drilling water wells. Over the past four years, we have had 70,000 engineer soldiers—60,000 of them from the Reserve Components—gain experience in Central America. Similarly, doctors and other health care professionals from Army medical units are carrying out humanitarian and civil assistance activities. The bonds that can be established by these efforts foster trust and mutual respect—essential ingredients if a program of this type is to succeed.

In Central America, the Army is helping to support regional stability through projects ranging from construction of roads and airfields to drilling water wells. Over the past four years, 70,000 Army engineers—60,000 of them from the Reserve Components—have participated in such projects (Photo by Sergeant Richard Creed).

To leap out and think strategically about the possibilities of this nation-building concept means considering ways it might be expanded. Why not, for example, use more extensive involvement of military engineers in development assistance? Why not the expansion of this concept to other geographic areas? Why not to Southeast Asia? Or Africa?

Conclusion

In our early history, the Army provided the principal federal capability to establish, expand, and protect our nation on the American continent. Although, a myriad of federal, state and local governmental agencies have assumed a greater public sector role in our country through the years, there remains an essential place for our Army in the American scene—both at home and abroad.

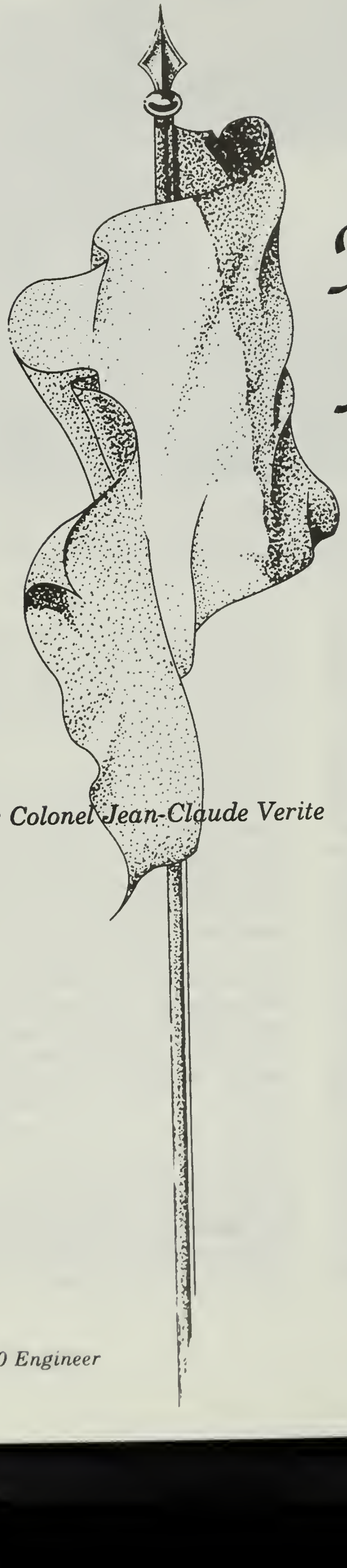
Our role ranges from providing a maturing experience for our young men and women, who will later take their places as productive citizens in private life, to responding to national disasters, to securing the peace by deterring armed conflict across the entire conflict spectrum.

Armies are relevant and must project that relevancy to the publics they serve. For if we fail in that, and are weakened during a perceived lull in external threats, we may ultimately fail our nations in their hour of need.

Our Army must maintain its credibility and relevance in the public mind, even while the perception of threats to our national security are constantly changing. We must be viewed as a multi-purpose asset in the support of national objectives both within and beyond our national boundaries. We must have diverse utility while maintaining our essential war fighting capabilities.

The United States Army is a strategic force. It is the American citizen's general military servant. As a strategic force, the Army has the strength to prevail on the AirLand Battlefield, and it has the capability to positively influence the management of peace on a restless planet. God willing, the Army's leadership of today and tomorrow will have the strategic vision to lead us beyond the battlefield...to a nation and a world at peace.

Lieutenant General Henry J. Hatch has served as the Chief of Engineers and Commander of the U.S. Army Corps of Engineers since June 1988.



French Engineer Alternatives For National Service

By Colonel Jean-Claude Verite

As Lieutenant General Hatch said in his 1989 Kermit Roosevelt Lecture, (page 12) "The Army...must step up to the role as the nation's general military servant. This role requires the Army to carry out a range of tasks beyond the battlefield—to prevent war—to manage peace—to undertake the nation's most difficult and tedious tasks. Soldiers fighting forest fires in the American West and engineer units building roads in Central America are just two contemporary examples of these tasks."

The French Army too, because of historical circumstances, has had to face this expanded dimension of military service. For many years, French engineers, in addition to maintaining their readiness for combat missions, have successfully met "beyond the battlefield" missions.

Here, I will cover four maj
areas of French engineer contrib
tions to national service, includi
nation-building in Africa, tl
Paris Fire Brigade, Civil Safe
and Adapted Military Service.

The Nation-Building Effort

As the French colonial era w
drawing to an end, we signed
cords with former colonies th
were designed to continue Fren
assistance in the development
newly independent nations. Ma
government agencies are invol
in this on-going effort, and
French Army has also taken
important role.

In addition to any straightf
ward military training that m
be requested by these natio

French engineers give extensive training in construction techniques to these new countries. Officers and NCOs have provided the citizens of these former French colonies with instruction in both vertical and horizontal engineering. They also participate in the design and construction of badly needed nation infrastructure. In addition, some highly qualified engineers, as part of their one-year mandatory military duty, are selected to serve as technical advisors in these developing areas.

The Paris Fire Brigade

Following a disastrous Paris fire in 1867, the French government decided that the Army would take over the responsibility for firefighting in the capital city.

Since that time, the Brigade des Sapeurs Pompiers de Paris, a military engineer unit, has accomplished the mission with professionalism and efficiency. The unit carries out an average of 300,000 missions every year. The brigade's motto, "Save or Perish," has been proven many times, as French sappers have died trying to save the property and lives of their fellow citizens. About 400 engineers are injured every year in firefighting duties in the Paris metropolitan area.

The 7,200-man brigade includes three Fire Groups of eight companies each. The force has 250 officers, and about 1,000 of the enlisted men are draftees.

The fire brigade enjoys immense popularity among Parisians, and they are always greeted with applause when taking part in the annual Bastille Day military parade. Their popularity is well earned, though, because they face the threat of death and injury daily in their duties.

In addition to their Paris-based duties, members of the brigade are also called upon to serve as reinforcements for fire and rescue teams sent to help foreign countries during major disasters.

Civil Safety

Another area of French engineer contributions to national service is Civil Safety, which is served by the three Training and Rescue Units for Civil Safety (UIISC). These units, created in 1968, are part of the Engineer Corps, but are equipped and manned by the Department of the Interior. Such close cooperation between civilian government agencies and the Department of Defense has been a keystone to the Army's national service program.

Career soldiers devoted to Civil Safety include 92 officers and 235 noncommissioned officers. Of these, 75 percent are engineers. Also assigned to these units are 1,250 draftees.

The general mission of these soldiers is twofold: to rescue people from accidents, disasters and other incidents, and to protect the environment. Their area of responsibility includes not only the entire country, but overseas areas as well.

The units are equipped to fight forest fires, clean up environmental pollution, and rescue victims of earthquakes and other casualties. These units have a dual responsibility and could be called upon to perform the same duties in combat areas as well.

The accompanying list of major missions conducted by the UIISC, on page 22, indicates the diversity of missions performed by these units.

A member of the French Engineer Paris Fire Brigade listens for possible survivors of the 1985 earthquake in Mexico City. Such specialty teams have been highly successful in saving lives, and they are often sent to overseas disaster sites (French Army photo).

Major UIISC Missions Since 1976:

1976 - Earthquake rescue, Frioul, Italy
1978 - Environmental clean-up, Amoco Cadiz tanker, Brittany, France
1980 - Environmental clean-up, Tanio tanker, Brittany, France
- Earthquake rescue, El Asnam, Algeria
- Earthquake rescue, Mezzo Giorno, Italy
- Flood relief, Savoy, France
1981 - Flood relief, Nice, France
- Avalanche relief, France
- Flood relief, near Paris
1982 - Flood relief, Andorra
- Hurricane relief, Auvergne, France
- Avalanche relief, France
1983 - Hurricane Veena relief, Tahiti
- Rescue, terrorist attack, Beirut, Lebanon
1984 - Hurricane Kamisy relief, Comores Islands
1985 - Earthquake relief, Mexico City
1986 - Emergency snow clearing for southern France
- Earthquake relief, Kalamata, Greece
1987 - Storm relief, Brittany, France
1988 - Environmental clean-up, Brittany/Normandy, France
- Technical firefighting assistance, Peru
- Flood relief, Nimes, France
- Earthquake relief, Armenia
1989 - Building collapse relief, Toulon, France
- Hurricane Hugo relief, Guadeloupe, West Indies
- Medical assistance, Rumania

Adapted Military Service

Efforts to correct the root causes of regional instabilities are part of the new strategy for military forces of the future. The French Army's Regiments du Service Militaire Adapte (SMA) (Adapted Military Service Battalions) support that strategy in overseas areas. These unique units provide assistance to French overseas territories in education, civil works, and other supporting programs. This assistance is provided in cooperation with the French government's Department of Overseas Districts and Territories.

Civil Safety (UIISC) soldiers prepare to clear storm damage from Hurricane Hugo on the Island of Guadeloupe in 1989. The UIISC performs duties both overseas and at home in France (French Army photo).

Created in 1960, the SMA units serve Martinique, Guadeloupe, Guyana, Reunion, Mayotte, and New Caledonia.

The SMA program helps overseas territory draftees, during their initial military training and subsequent national service, to develop a moral and civic sense of duty. The SMA also prepares these young citizens for their professional life by giving them a technical education. The soldiers are then given the opportunity to participate in local community work programs.

The different job specialties taught by the battalions include agriculture, commercial fishing, horizontal and vertical construction, forestry and saw mill operations, mechanics, and food service operations.

This combination of vocational education and real work experience benefits the community and allows the soldiers to reenter civilian life with job skills. In 1989, more than 2,000 draftees received training in these skills.

The SMA units also provide assistance with disaster emergency plans and operations. Recent rescue and clearing efforts include Hurricane Firinga on Reunion Island, and Hurricane Hugo in Guadeloupe.

By giving young people basic job training and making them more conscious of their responsibilities as citizens, the SMA units make a significant contribution to the welfare and stability of French overseas territories.

"Always To Serve"

In this rapidly evolving world, when long-standing ideas of the military threat are changing before our eyes, national defense

Above: **A UIISC rescue team**
searches earthquake rubble for vic-
ims with a specially trained dog.
This rescue and relief mission to
El Asnam, Algeria, in 1980, is one
of many such operations con-
ducted by French Army engineers
French Army photo).

Right: **Members of the Paris Fire**
Brigade make a final check of a
Paris train wreck in 1987 during the
inal stages of a rescue operation.
The unit carries out an average of
00,000 firefighting and rescue mis-
sions every year (French Army
hoto).

olicies must be reevaluated. Na-
ions around the world are ex-
mining the role of their military
orces, and many have scaled back
oth the budget and the man-
ower of their armies. To maintain
key role in national service, ar-
ies must seek and adapt to new
issions. These new missions, ac-
omplished in addition to their
aditional military roles, must
emonstrate to the nation the
alue of army expertise and
rofessionalism.
French Army engineers have
een innovators in these new
imensions of national service.

Faithful to their motto of "Sometimes To Destroy, Often To Build, Always To Serve," French engineers have demonstrated their ability and willingness to serve "beyond the battlefield."

Colonel Verite is the French Liaison Officer to the Engineer School. He previously served as district commander, Engineer Military Construction District of Marseille, France. He has served as Chief Engineer Officer, United Nations Interim Force in Lebanon, in 1984-85; Project Officer for the Military Construction District of Tahiti, and deputy commander of the 5th Foreign Regiment (French Foreign Legion) in Mururoa, Polynesia. He is a graduate of St. Cyr Military Academy and the French Army War College.

Training to Standards

By Ken Foster

"Failure to follow procedures" is a term frequently used in connection with accidents, and it is a common safety denominator within the engineering community. Situations that fall in this category include supervisors who allow unqualified personnel to operate equipment, backing vehicles without ground guides or adequate vision, and failure to follow misfire procedures when training with demolitions. The results of our failure to follow procedures are very costly in terms of dollars, equipment, and human resources.

During fiscal year 1989, 610 engineer soldiers were accidentally injured, 24 of them fatally. This number of injured soldiers equates to three company-sized units. Their injuries cost $3,574,335, and damage to government property amounted to $599,000, making a total cost of more than $4 million.

During the 5-year period October 1984 - April 1989, 16 fatalities occurred in engineer units during demolition training, fast water training, and Army motor vehicle operations. "Failure to follow procedures" was a primary factor in all of these accidents.

The purpose of safety in military training is to enhance soldier proficiency not to inhibit or remove realism from the training. We must remember that the soldiers' welfare is our first consideration, and that a well trained force is a safe force.

Preventing accidents requires a pro-active approach to all we do through education, engineering and enforcement. However, once an accident happens, we must establish procedures to properly analyze it. The first step is a thorough investigation to establish the who, why, when, what, where and how of the incident. This step is essential to properly identify all the causes. The second step is to develop and implement countermeasures that will prevent similar occurrences in the future.

Soldiers at Fort Leonard Wood, such as Private Greene, are taught the correct throwing procedures while using inert grenades. By learning proper procedures, they reduce the risk of serious accidents (TASC photo).

Motor vehicle accidents are expensive in terms of human resources and equipment. The operator of this forklift was descending a hill at excessive speed for conditions when he lost control and overturned. Such accidents cost the government thousands of dollars each year (TASC photo).

The best solution, of course, is to remove the source of the hazard but this is not always possible. For example, if a bush creates a blind spot at an intersection, the hazard can be removed. When it cannot be removed, as in demolition training, the next best thing is to reduce the accident risk by using a physical guard or controls and educating personnel exposed to the hazard.

Accident prevention includes the enforcement of proper procedures, which is important leader business. Leaders who fail to enforce established procedures should expect an increased accident rate within their area of responsibility. Safety is not just commander business, it is NCO and individual business. We all share a part of safety responsibility.

Supervisors need to lead by example, set high standards, and conduct operations to meet those standards. Supervisors and commanders must ensure that soldiers know and become proficient with the equipment they operate. They must motivate their soldiers to work safely and to identify and control risks. If we teach soldiers the benefits of safe performance, they will be motivated to perform to standard.

Safety must be integrated into all operations. Safety awareness should become a way of life for our soldiers—on and off the job.

We will never eliminate all engineer-related accidents from our work environment because the calculated risk dictates otherwise. However, we can and must reduce the accident risk by ensuring that our personnel follow and understand prescribed procedures.

Because we learn from sharing experiences, we need to hear from you. Help us share your knowledge and experiences with the rest of the engineer community. Send letters to: Headquarters, U.S. Army Engineer Center, ATTN: ATZT-S, Fort Leonard Wood, MO 65473-5000. Or, call (314) 563-5000, AV 676-5000.

Ken Foster is a safety specialist assigned to the Engineer Branch Safety Office at Fort Leonard Wood, Missouri.

The Essayons Program:

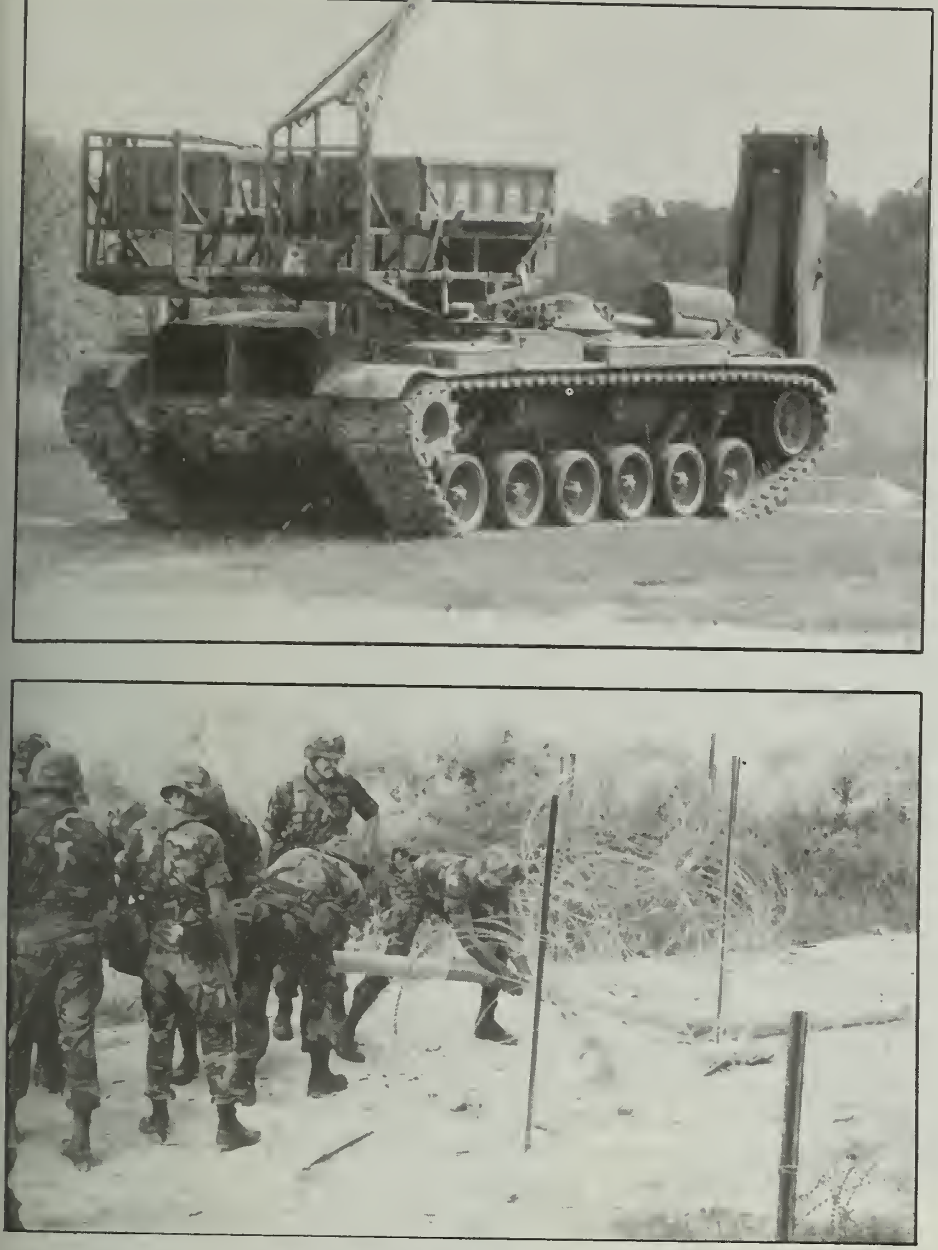
From Brainchild To Drawing Board

By Chester A. Kojro

Sometimes, like the old saying goes, "you can't see the forest for the trees." And like any other large organization, that occasionally applies to the military. Despite the best efforts of a long line of experts involved in developing Army equipment, doctrine, force structure or training, mistakes and shortcomings can happen.

The Engineer Center knows that the best solutions to problems often come from the soldiers who have to confront those problems on a daily basis. To provide engineers with easy access to "the system," the Engineer Center developed the Essayons Program. The program is designed to solicit recommendations for changes in engineer systems or concepts.

Since the program began in September 1988, several recommendations from field units have been evaluated, including a Demolition



Three Essayons Program recommendations: opposite page, the Engineer Squad Vehicle (ESV); top, the Armored Vehicle Launched MICLIC, and the Demolition Effects Simulator (DES), in its bangalore torpedo configuration (U.S. Army photos).

Effects Simulator (DES), the Armored Vehicle Launched MICLIC (AVLM), and the Engineer Squad Vehicle (ESV). An overview of these three evaluations follows.

Demolition Effects Simulator (DES)

In 1988, soldiers from the 65th Engineer Battalion, 25th Infantry Division (Light), developed and produced the prototype of a demolition effects simulator. Through the Essayons Program, they submitted the project to the Engineer School for evaluation.

The battalion's DES comes in two configurations. First, satchel charges or other above-ground demolitions are simulated using a chalk charge. This consists of a detonator with a large knot tied into detonating cord (det cord), and placed into a sandbag filled with powdered chalk.

The second configuration simulates a bangalore torpedo, and consists of det cord placed inside a 6-foot long cardboard tube. The tube is filled with approximately 7 pounds of powdered chalk and sealed with tape. Prepared tubes can then be connected and detonated together. The detonation system for both consists of an M60 fuse ignitor, a time fuse, and a nonelectric blasting cap.

Testing of the DES was done at Fort Knox by the Engineer Test Division of the Test and Experimentation Command (TEXCOM), and the Armor-Engineer Board (ARENBD), September 11-15, 1989.

The chalk charge was used to simulate steel-cutting and tree-cutting (abatis) charges. The bangalore configuration was used to simulate wire and mine obstacle-breaching missions.

Both configurations were found to be effective training simulators. Soldiers were able to work with real fuse ignitors, time fuses, det cord and blasting caps without actually destroying trees, bridges or other targets. The cardboard tubes did a good job of simulating bangalores, although further modifications now under study would enhance realism.

Armored Vehicle Launched MICLIC (AVLM)

The AVLM concept was developed by the 16th Engineer Battalion to improve the survivability of soldiers deploying a mine clearing line charge (MICLIC). They proposed providing these soldiers with a self-propelled armored vehicle. For evaluation purposes, an armored vehicle launched bridge (AVLB)—minus the bridge—was temporarily modified to permit the mounting of two MICLICs.

The test configuration was constructed by attaching a frame, fabricated from two I-beams and various pieces of scrap metal, to the rear deck of the AVLB. The MICLIC launchers were then connected to the frame with clamps.

Testing was conducted at Fort Knox by the Engineer Test Division, again by TEXCOM and ARENBD, September 1-29, 1989. The AVLM is much more mobile than the trailer-mounted MICLIC. Compared to the AVLB with its bridge mounted, an increase in vehicle speed was noted. Visibility and vehicle access were also improved.

Installation of the proposed MICLIC assembly required less than one hour on all test missions, using equipment common to an engineer battalion.

A drawback to the proposal is that the AVLB's bridge-launching "foot" partially blocks the MICLICs, requiring the foot to be lowered prior to firing. This resulted in delayed launch time. Too, this configuration left the MICLIC assemblies exposed and vulnerable, and prevented the use of the AVLB for its primary role of launching bridges.

While this proposal has merit, its limitations are still being studied by the Engineer School's Directorate of Combat Developments (DCD).

Engineer Squad Vehicle (ESV)

This recommendation called for converting a turretless tank into an engineer squad vehicle that would have a tank's mobility and survivability. The concept is similar to the Israeli Puma, which combines a Centurion tank chassis with a new armored superstructure, or casemate. The Engineer School envisions the ESV as an interim step toward the planned Sapper Vehicle.

> *"Changes begin with the soldier, and the Essayons Program continues to be a useful tool for evaluating ideas from the field."*

The ESV would consist of an Abrams chassis with an armored crew compartment and superstructure. A small rubble-clearing blade would also be mounted. An Abrams hull was not available for the test, so an M60A2 chassis was used. The steel superstructure was fabricated by ARENBD.

Crew access was through the track commander's (TC) hatch on top, and two gull-wing shaped doors in the rear of the superstructure. Seven seats were mounted within the superstructure, in addition to the normal driver's station. Large steel tool boxes replaced the tank's side fender sponson boxes, and a storage rack for munitions and personal equipment was added above the engine compartment.

During the test, a mineplow from an Abrams was attached to the vehicle using fabricated adaptors. The plow was used for excursion testing in mine breaching, and was not intended to be an ESV capability.

Testing was conducted by the Engineer Test Division of TEXCOM and ARENBD at Fort Knox from September 22 through November 30, 1989. During the evaluation, the ESV was compared against an M113 for its effectiveness as a squad carrier.

The ESV was found to be operationally effective, and has improved armor protection and increased external equipment storage space. Unlike the M113, the ESV can employ tank-mounted mine plows and rollers, providing the potential for alternate mission capability.

It does have drawbacks, however. Entry and exit times are much longer than the M113, and there is less internal storage space.

Since the test superstructure was made of brassboard and total vehicle weight was not realistic, ESV mobility could not be tested.

The operational tradeoffs of a tank chassis-based engineer carrier are still being evaluated by the Engineer School's DCD.

Send It In!

Changes begin with the soldier, and the Essayons Program continues to be a useful tool for evaluating ideas from the field.

While not every proposal makes it to the test stage, all are thoroughly staffed before a final decision is made.

Engineers are encouraged to send your Essayons recommendations to : Commandant, U.S. Army Engineer School, ATTN: ATSE-CDT, Fort Leonard Wood, MO 65473-6620.

Mr. Kojro is a combat developments materiel analyst for the Engineer School's Directorate of Combat Developments. He is a former Armor officer, and previously served as a branch chief for the Directorate of Combat Developments at the Armor School. He is a graduate of the University of Illinois.

(Personal Viewpoint, continued)

When not under an active duty chemical battalion, a chemical company needs to be within the daily command and control of a corps or divisional combat engineer battalion. This places the company in a well defined and functional battalion environment with solid combat-multiplier experience and like-type battle focus.

Like a combat engineer company, the chemical company must be able to provide combat multiplying expertise to the task force commander. Both engineer and smoke assets shape the battlefield through obstacles and obscuration. Also, mobility and countermobility are mission-essential tasks for both of them. Thus, a similar type of leadership development is needed for both the castle and the crossed retorts wearers. That depth is found in the engineer battalion, where company commanders maintain a clear fix on maneuver support.

Other factors favor this solution. The chemical company's type and density of equipment are familiar to the engineer motor pool, and the engineer battalion is structured and experienced in handling the maintenance challenges. In addition, flexibility in independent operations and proficiency in METT-T configurations are common in both engineer and chemical maneuver support.

The bottom line is clear. We must organize and train in garrison and field as we will be in battle. The mentoring, training, maintaining, caring, and leading of a chemical company are essential to its overall readiness. It is not logical to place this asset under a staff officer or within a rear battle organization. We must avoid branch parochialism and subscribe to a true battle-focused doctrine.

Can a chemical company find its niche, happiness, and combat proficiency within a combat engineer battalion? Absolutely! Since February 1989, the 761st Smoke and Decon Company, a forces command corps-level unit located at Fort Ord, California, has been an integral part of the 14th Combat Engineer Battalion. Before that time, the 761st was located within a mixture of unique TDA and TO&E units under a medical battalion. Operational readiness levels, maintenance systems, administrative actions, professional development, and (most importantly) battle focus were a mixed lot. Given this situation, the company could not be expected to reach any solid level of sustained readiness. Now, as part of a combat battalion, the combat chemical soldiers are properly oriented and rock-solid ready.

This relationship is the answer. And it is not new. In World War II, the 14th, as part of the 36th Combat Engineer Regiment, accumulated 10 battle streamers. Within that regiment were a smoke company and a decon company. As an integral part of the 14th, the 761st Smoke and Decon company is now on a winning azimuth. Together they have shown where the chemical company needs to be.

Lieutenant Colonel Herb Harback is commander of the 14th Combat Engineer Battalion (Corps),. Fort Ord, CA. He has served in various command and staff positions, including executive officer, bayonet combat support command, 7th Infantry Division; deputy commander, 7th Engineer Brigade, VII U.S. Corps; brigade S-3, 7th Engineer Brigade; aide-de-camp to the commanding general, Western Command; company commander, 15th Engineer Battalion, 9th Infantry Division; and assistant division engineer, 3rd Infantry Division.

Engineer Problem

You are a combat heavy platoon leader in Panama. Your mission is to design a roadside ditch for a main supply route. The ditch must accommodate runoff from an area measuring 12 acres.

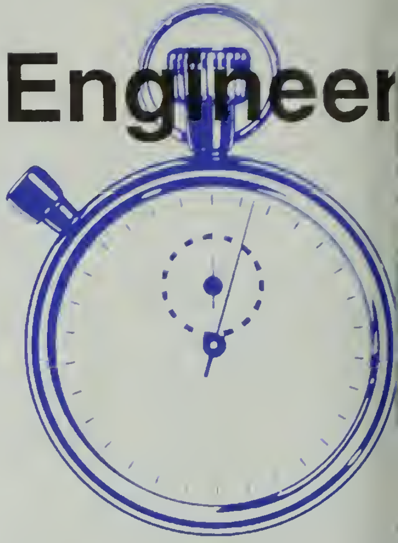
Additional Information:

Soil type - ML without turf
Slope of ditch - 4 percent
Reference manual - FM 5-335

Engineer Solution on pages 36 and 37.

Solving the Task Force Engineer

Time Crunch



> *"It is very easy to accept dogma...when one reaches the comfortable state of believing that because certain ideas have worked in the past, it is not necessary to ask whether they can be improved upon."*
>
> *S.L.A. Marshall*

Almost every task force engineer (TFE) wishes he had more planning time. Often we find the TFE producing a written countermobility matrix, a survivability matrix, a time-line of events, an engineer annex instruction page, and an obstacle overlay. Without a doubt, this paperwork nightmare is a bad dream for both the engineer and the TF he serves. The TFE must be able to immediately develop a realistic plan and quickly record it in a readable format. This article proposes a fast defense planning method that makes effective use of that valuable time.

Through the years, task force planning has evolved into a drawn-out process loaded down with repetitive paperwork. This process is described in FC 5-71-2, *Engineers in the Tank and Mechanized Infantry Task Force*. It also takes too much time to complete. The time-line contains redundant information that is on the matrices. It is normally used only to present a clear picture to the maneuver commander. Calculating a bill of material for each obstacle, as is often done, is a long process that should be performed by the squad leaders. Have you ever seen the look on the face of a maneuver commander after he receives the orders brief? He tends to look a little puzzled at all the pages of engineer planning and wonders what part of it involves him. Chances are, he's not going to read it at all. And if he doesn't, you've been wasting your time.

The answer to the "There must be a better way..." question is the planning method which follows. It is easy to understand and offers speed, simplicity, and clear command and control. An overview of this method is shown at Figure 1.

Essentially, the process revolves around two documents: the obstacle overlay and the engineer execution matrix. You can record all engineer tasks, coordinating instructions and details on one form. You may add more forms if the defense is particularly long in duration. The obstacle overlay is drawn in standard fashion. One overlay and one matrix—that's all. It's fast and easy to understand.

Engineer Execution Matrix

A vertically oriented time-line serves as the framework for this method (Figure 2, page 32). Across the top are blank spaces for unit designations (normally engineer platoons) and heavy equipment teams. The first column on the left is an hour time scale, which ranges from the beginning of the defense preparation to a time after the expected attack. Increments of an hour or two work best.

By Captain Daniel P. McKenrick

Below the time-line area are several blocks used for specific unit missions, such as class IV recovery, lane closings, scatterable mines, etc. Under that is a remarks block for operation-specific needs and the priorities of support or work (if not stated earlier, in paragraph three of the operations order [OPORD]). At the bottom of the form is a sample mission block with its elements explained and any abbreviations spelled out. Simple, but it prevents misunderstandings.

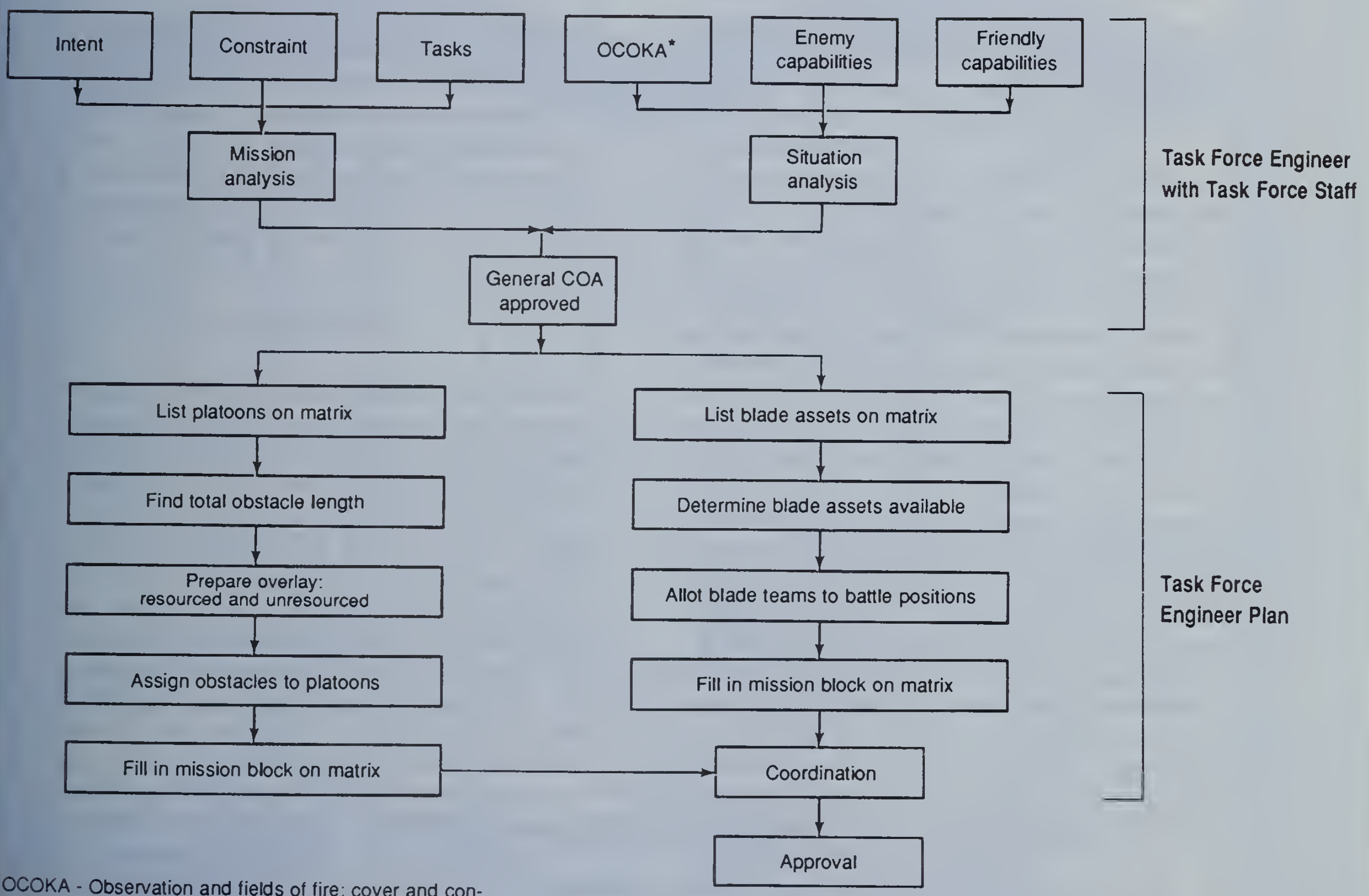
Before trying out this method on a task force defense, there is one reference that can simplify life for any task force engineer. It is an obstacle logistics and manpower reference sheet (Figure 3, page 33). You will have to create this from several field manuals and temper it with experience. It is important that the hours for obstacle construction accurately reflect your unit's capabilities. Later you will see how this makes planning much easier.

Gathering Information

Once you receive the mission, immediately move to the task force tactical operations center (TOC). Get with the TF commander or S-3 for a briefing on the concept and intent of the operation. If you train often with the task force, you are familiar with how the boss thinks and can quickly put things into perspective. By developing a satisfactory plan the first time around, you'll save a lot of time.

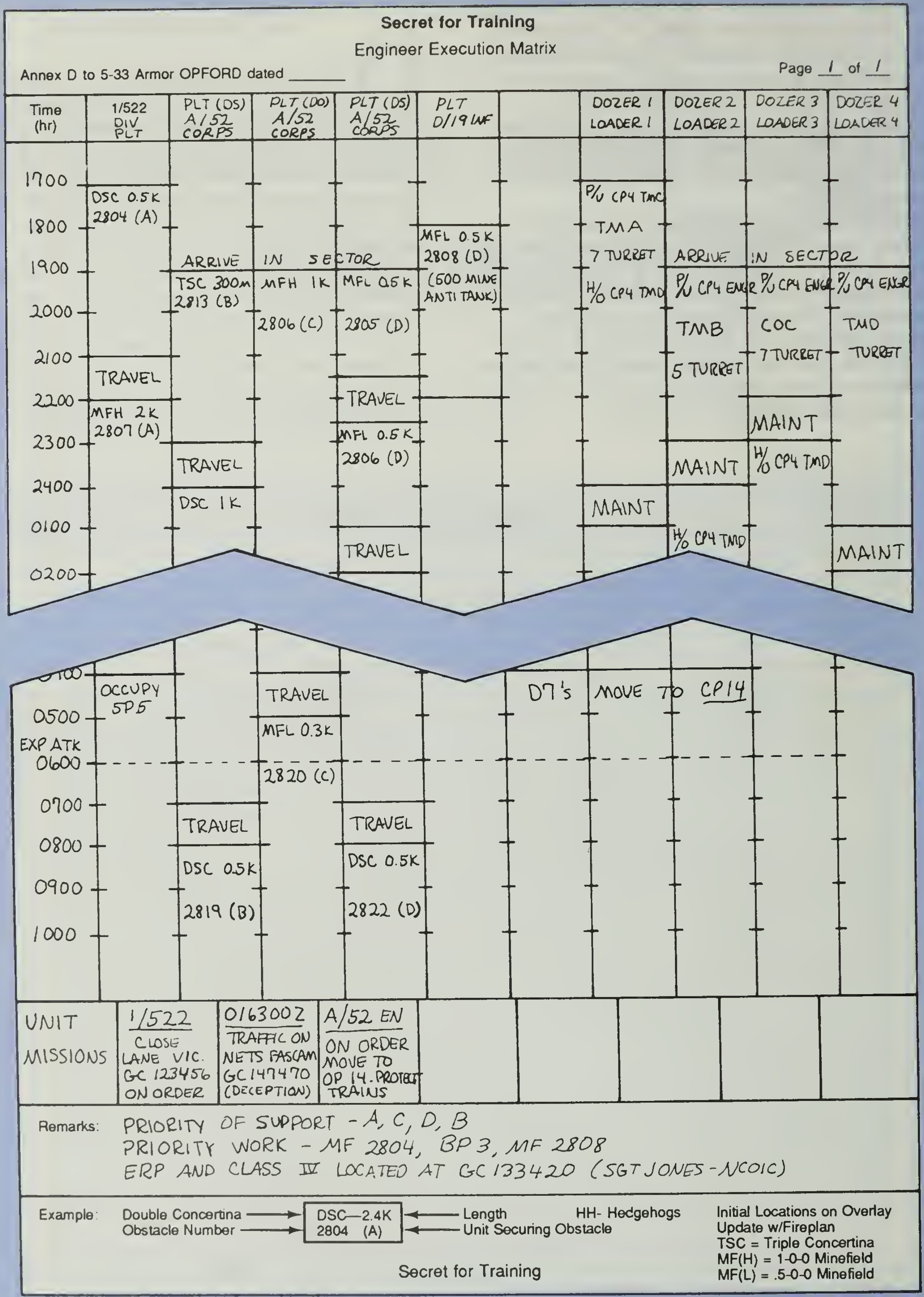
The old saying, "know your boss," still holds true. Read the brigade order, focusing on the commander's intent and the engineer annex. From the order, determine the brigade obstacle belts, obstacle-restricted areas, quantities of class IV and mines, the expected time of attack, and the presence of other engineer units that may augment you.

Making the Plan


Intent
Constraint
Tasks
OCOKA*
Enemy capabilities
Friendly capabilities
Mission analysis
Situation analysis
General COA approved
Task Force Engineer with Task Force Staff
List platoons on matrix
Find total obstacle length
Prepare overlay: resourced and unresourced
Assign obstacles to platoons
Fill in mission block on matrix
List blade assets on matrix
Determine blade assets available
Allot blade teams to battle positions
Fill in mission block on matrix
Coordination
Approval
Task Force Engineer Plan

*OCOKA - Observation and fields of fire; cover and concealment; obstacles; key terrain; avenues of approach.

Figure 1



Secret for Training

Engineer Execution Matrix

Annex D to 5-33 Armor OPFORD dated _______

Page 1 of 1

Time (hr)	1/522 DIV PLT	PLT (DS) A/52 CORPS	PLT (DO) A/52 CORPS	PLT (DS) A/52 CORPS	PLT D/19 INF		DOZER 1 LOADER 1	DOZER 2 LOADER 2	DOZER 3 LOADER 3	DOZER 4 LOADER 4
1700	DSC 0.5K 2804 (A)						P/U CP4 TMC			
1800		ARRIVE	IN	SECTOR	MFL 0.5K 2808 (D)		TMA 7 TURRET	ARRIVE	IN SECTOR	
1900		TSC 300m 2813 (B)	MFH 1K	MFL 0.5K	(500 MINE ANTI TANK)		H/O CP4 TMD	P/U CP4 ENGR	P/U CP4 ENGR	P/U CP4 ENGR
2000			2806 (C)	2805 (D)				TMB	COC	TMD
2100	TRAVEL			TRAVEL				5 TURRET	7 TURRET	TURRET
2200	MFH 2K 2807 (A)			MFL 0.5K 2806 (D)					MAINT	
2300		TRAVEL						MAINT	H/O CP4 TMD	
2400		DSC 1K					MAINT			
0100				TRAVEL				H/O CP4 TMD		MAINT
0200										
	OCCUPY 5P5		TRAVEL			D7's	MOVE TO	CP14		
0500			MFL 0.3K							
EXP ATK 0600			2820 (C)							
0700		TRAVEL		TRAVEL						
0800		DSC 0.5K		DSC 0.5K						
0900		2819 (B)		2822 (D)						
1000										

UNIT MISSIONS	1/522 CLOSE LANE VIC. GC 123456 ON ORDER	0163002 TRAFFIC ON NETS FASCAM GC147470 (DECEPTION)	A/52 EN ON ORDER MOVE TO OP 14. PROTECT TRAINS					

Remarks: PRIORITY OF SUPPORT - A, C, D, B
PRIORITY WORK - MF 2804, BP 3, MF 2808
ERP AND CLASS IV LOCATED AT GC 133420 (SGT JONES - NCOIC)

Example: Double Concertina → DSC—2.4K ← Length
Obstacle Number → 2804 (A) ← Unit Securing Obstacle

HH- Hedgehogs

Initial Locations on Overlay
Update w/Fireplan
TSC = Triple Concertina
MF(H) = 1-0-0 Minefield
MF(L) = .5-0-0 Minefield

Secret for Training

Figure 2

Obstacle Logistics and Manpower Reference Sheet

DIST (m)	PKT TSC	PKT DSC	CONC TSC	CONC DSC	BW	MINE 0.67-	MINE 1-0-	PHR TSC	PHR DSC	PHR M.67	PHR M1-
100	55	20	20	14	1	70	100	1.25	0.75	0.75	0.5
300	165	60	60	42	3	200	300	4	2.5	2.5	1.5
500	275	100	100	70	5	335	500	6.5	4	4	2.5
700	385	140	140	98	7	470	700	9	5.5	5.5	3.5
1000	550	200	200	140	10	670	1000	13	7.5	7.5	5
1300	715	260	260	182	13	870	1300	17	10	10	6.5
1500	825	300	300	210	15	1000	1500	19	12	12	7.5
1700	935	340	340	238	17	1135	1700	22	13	13	8.5
2000	1100	400	400	280	20	1335	2000	25	15	15	10
2300	1265	460	460	322	23	1535	2300	29	18	18	12
2500	1375	500	500	350	25	1670	2500	32	19	19	13

Figure 3

Review enemy intelligence with the S-2, focusing on opposing engineers and their assets. It is likely that you will be able to provide important information to the S-2 by analyzing enemy strengths and capabilities. Using OCOKA, analyze the terrain with an eye on potential digging problems in company and team battle positions. Armed with all of this information, you are ready to begin.

Obstacles

Engineer tasks are accomplished by two forces: soldiers and heavy equipment. The nature of obstacles requires manpower, with the exception of anti-tank ditches. Vehicle fighting positions and most mobility positions require heavy equipment. For these reasons, the top of the form readily lends itself to placing platoons (countermobility) on one side, and heavy equipment like ACE/bulldozer and scooploader teams (survivability and mobility) on the other. For the sake of convention, place units on the left, and equipment teams on the right.

Therefore, the first step is to list, across the top of the form, the engineer platoons expected to be available.

Next, determine how many meters (m) of linear obstacle can be constructed. To do this, look at Class IV materials within the task force and those expected to be available through brigade. Using your obstacles logistics and manpower reference sheet, enter the quantity of material available and record the corresponding obstacle distance, in meters, from the table. Since many obstacles require more than one type of material, choose the limiting amount for that obstacle.

The next step is to prepare an obstacle overlay, based on the commander's intent, the desired effects on the enemy, and the terrain. Take care not to exceed the sum of meters logistically possible. This ensures that your obstacles can be completed, and will eliminate the need for drawing up a separate bill of materials (BOM) for each obstacle. Let the squad and platoon leaders calculate the BOM to draw the materials. You only need to know that there is enough material to construct the obstacle.

This logistics constraint leads to an overlay which realistically portrays the number of obstacles that can be effectively emplaced. Now assign obstacle numbers. These will be used to cross-reference the matrix.

If, after allocating all available materials based on the commander's priorities, you find that your proposed obstacles are unable to produce the desired effect on the enemy, you can now plan the unresourced obstacles. If you have planned properly, your unresourced obstacles will be those with less priority.

Be sure to check with the task force S-4 before you say the materials are unavailable. Often, additional materials may be allotted to you because of changing priorities. It is very important for the

"Practice this method with your task force staff. . . They will be able to see the 'big picture,' and the execution of the TF engineer plan will be a lot easier."

commander to know which planned obstacles are not resourced. I suspect he will be very interested in these. You are telling him that they are essential to the defense—but you cannot build them because of material shortages. The subject of important but unresourced obstacles tends to get quick "radio publicity," and may help you get the necessary materials.

Now, assign the specific obstacles as tasks to the platoons. Often the corps company and the divisional platoon have missions that take them from one end of the battlefield to the other. Because engineers often travel long distances, elements are difficult to control and responsibilities may become foggy. By establishing a convention, this problem can be solved.

Begin by assigning the foremost obstacle on either the left or right of the battlefield to a platoon. Working from front to rear, assign that platoon tasks until it has no available time. Then, working from front to rear again, assign tasks to the next platoon. Assigning tasks across the battlefield in this manner is much like hanging wallpaper. You start at the top, work your way down, and then repeat the process.

Using this technique to assign missions ensures that the most important tasks are started first across the whole sector. It also creates convenient areas of responsibility. There is no need to establish formal boundaries because the task force will want to maintain flexibility.

Also, each engineer squad will know which company team it is supporting and who commands that unit. This is an advantage when the squad leader coordinates the placement of obstacles. Later, if the company/team commander discovers a problem with an obstacle to his front, he need not wander the battlefield to get it straightened out. The engineer unit that constructed it will still be to his front. This lends itself to a working relationship between the overwatching maneuver unit and the engineers who support it. And the closer coordination between the two will solve many problems encountered under the present system.

The next step is to schedule the tasks on the form. This requires a few rules. Between each task, the engineer platoon needs some time, generally 30 minutes to an hour, to obtain materials, make site coordination, and reorganize. Be sure to block that time out, and call it "travel time." The platoon should enforce a sleep plan (the obstacle logistics and manpower reference sheet reflects this) so the entire platoon doesn't have to shut down during obstacle construction.

To fill in the block, draw a line across the platoon column at the hour the mission is to start. From the overlay, determine the length of the obstacle. Refer to the logistics and manpower reference sheet to determine the platoon hours required. This amount of time determines how far down to draw the end of the task line. Between these two lines, place the four key elements of information. (Hint: When you are filling it out, the elements are listed at the bottom of the form for you—and everyone else—to see.) Enter the obstacle number, which can be referenced to the overlay to provide the type and location of the obstacle, the distance to the obstacle, in meters, and the unit overwatching the obstacle. Complete the "travel time" block next, and you are ready for another mission.

If needed, list obstacle locations in the mission blocks. However, this tends to cause limited coordination with overwatching units and is inaccurate when the obstacle is emplaced. Aside from direct observation, actual obstacle locations can be obtained from the company/team commander, who will report his fire plan obstacles to the TOC. In addition, the engineer unit constructing the obstacle will report actual locations through engineer channels.

The overlay shows the location and intent of obstacles. No one knows where an obstacle will actually end up until the maneuver unit sites it in. The task force engineer must approve any obstacle that varies significantly from its original location because moving the obstacle may alter its intent.

Heavy Equipment

Planning for heavy equipment use is much easier. Initially, you need to determine the number and types of fighting positions needed. Also determine mobility and anti-tank ditch requirements. These are usually secondary to survivability.

Now find out what equipment is available for the jobs at hand. A few equations make planning easy. Multiply the number of available ACE/bulldozers by the number of hours available for the defense.

Blades X available hours = blade hours

Subtract one-eighth to allow for maintenance and refueling. This means that every 8 hours the equipment will not operate for about an hour. This 1-hour block goes on the form later.

Blade hours X 7/8 = blade hours of work

Now divide the operating hours by the average time needed to construct a fighting position.

$$\frac{\textit{Blade hours of work}}{\textit{Hours per position}} = \textit{number of positions}$$

This provides the number of fighting positions that it is possible to build under the current circumstances. If there are other equipment needs, subtract those hours out before working the equation.

Now that you have a clear understanding of what is needed and what is available, allocate positions to the maneuver teams. Keep in mind the commander's intent, and the impact of the differing terrain on each company and team area.

Staying consistent with the commander's priorities, schedule the equipment on the form. To do this, draw a line across the column of the specific equipment team at the time it is to begin work. Determine how long it will take the equipment team to complete the task by multiplying the number of the team's assigned fighting positions by the average time needed to construct a position. Then draw an end-of-task line across the column at that time. Now, just as before, enter the four essential elements of information:

- who uses the equipment,
- how many positions are expected,
- pick-up information, and
- hand-off information.

After the end-of-task line, allow an hour to get the equipment to the next company battle position.

It is also helpful to put in the 1-hour maintenance blocks before recording any missions. Remember to stagger the maintenance blocks so that not all equipment teams are stopped at the same time. The contact team with the maintenance truck can only be in one place at a time.

If one equipment team takes too long to complete a priority mission, allocate another equipment team to assist. The stated mission priorities are your guide to solving allocation conflicts. Repeat this process until there are no teams available. If there is an equipment shortage, quickly request more assets from higher headquarters, using your form to support the analysis.

The Advantage

In a very short time, the analysis, planning, and recording of engineer support for the defense is complete. Copy the overlay and the one page matrix and you are ready for the orders brief.

The matrix time line and block format make it "maneuver" readable. The final plan is realistic and closely reflects those obstacles that will be on the ground at the expected attack time. Compared to the standard way of doing TF engineer business, the planning process is simpler and the writing requirements are significantly reduced. Informal command and control areas for engineers greatly assist leaders in the execution of the plan. Overall, this method allows the engineer to quickly arrive at a realistic plan and to record it in a readable format.

This method has proved valuable in all task forces of the 194th Armored Brigade on several deployments and exercises. Based on the recommendations of former maneuver battalion commanders, this method is taught to officers at the Armor School for their use in planning.

Practice this method with your task force staff. Train them on your new system. They will be able to see the "big picture," and the execution of the TF engineer plan will be a lot easier.

Captain McKenrick is an Army Reserve officer in New Jersey. While on active duty, he served with the 19th Engineer Battalion, and the 522nd Engineer Company, 194th Armored Brigade. He was also an instructor in the Engineer School's Department of Combined Arms. He is a graduate of West Point.

Engineer Solution

Use the Field Estimate Method to determine runoff:

$$Q = 2ARC$$

where: Q = Quantity of water, in cubic feet per second (cfs)
2 = Constant
A = Area, in acres
R = Rainfall intensity (Panama = 2.5 inches per hour)
C = Coefficient of runoff (ML soil without turf = 0.40)

Follow the ditch design procedure beginning on page 4-7 of FM 5-335.

1. Calculate Q:

$$Q = 2(12)\,(2.5)\,(0.40)$$

Answer: Q = 24 cfs

2. Determine cross section area (Aw), using the Continuity Equation:

$$Q = V \times Aw$$

where: V (velocity) = 4 feet per second (fps)

$$Aw = \frac{Q}{V}$$

$$Aw = \frac{24}{4}$$

Answer: ***Aw = 6 square feet***

3. Select ditch side slope ratios:

Answer: Roadside ditch is 3:1 to 1:1 ratio

4. Select ditch shape:

Answer: Because Q is less than 60 cfs, use a Vee-shaped ditch.

5. Compute depth of water:

Note: X and Y are the horizontal components of the side slope ratios; X = 3 and Y = l.

Engineer Solution

$$depth = \sqrt{\frac{2\,(Aw)}{X + Y}}$$

$$depth = \sqrt{\frac{2\,(6)}{3 + 1}}$$

$depth = 1.73$ feet **Answer: 1.7 feet**

6. Calculate cutting depth (CD):

$$CD = depth + 0.5 \text{ (freeboard)}$$

$$CD = 1.7 + 0.5$$

Answer: *CD = 2.2 feet*

7. Calculate top width of ditch (TW):

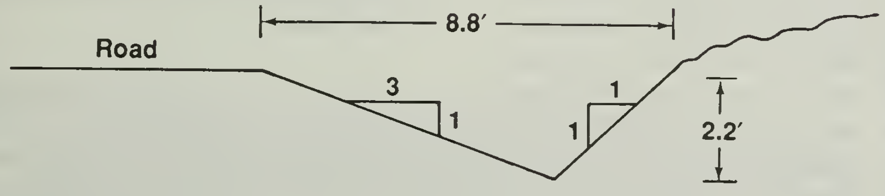
$$TW = (X + Y)\ CD$$

where: $X = 3$
$Y = 1$

$$TW = (3 + 1)\ 2.2$$

Answer: TW = 8.8 feet

8. Provide a sketch of the ditch



Erosion Control

The slope of the ditch is greater than 2 percent. Therefore, erosion control must be considered. Use check dams or line the ditch with rip rap.

This problem was submitted by CPT Michael F. Malsom, a drainage instructor at the U.S. Army Engineer School, Fort Leonard Wood.

A British View on American ADSM

By Major Alec A. Peebles, Royal Engineers

Author's Note: This article, as differences in word spellings will attest, was originally written for a British audience. While my views on the use of ADSM are not official in nature, I thought they might be of interest to readers on both sides of the Atlantic.

—Major Alec Peebles

Scatterable mines are a fact of life on today's battlefields. The United States, Soviet and West German armies already have scatterable mine systems in service. The United Kingdom will have the capacity when MRLS II and Vehicle Launched Scatterable Mine Systems (VLSMS) are in service in the 1990s. It is timely and relevant, therefore, to consider some of the practical lessons learned by our allies whilst we develop our own tactical doctrine.

The U.S. has had a family of scatterable mines (FASCAM) in service for some years. The artillery delivered element is an integral part of brigade and battle group level force-on-force training at the National Training Centre (NTC), where the effects of artillery delivered scatterable mines (ADSM) are simulated by fire markers and controllers.

In consequence, a number of effective tactics for the use of ADSM have been developed along with the practical techniques needed to ensure that ADSM is completely integrated into the all arms battle. Recently the U.S. 2nd Brigade Combat Team, from 4th Infantry Division (Mechanised), deployed to the NTC for a 3-week rotation. In my role as brigade engineer and British exchange officer, I was in a unique position not just to observe, but to be a principal player in all aspects of the use of ADSM.

Aim

The aim of this paper is to show, using the American experience, how ADSM should be used to fight the brigade deep battle, and to illustrate the degree of integration necessary between both staff and all arms units.

The Battlefield

The National Training Centre (NTC) is the United States Army's premier training facility. Several aspects of the facility are unique and, because of them, the facility offers the most realistic and demanding training environment possible for manoeuvering troops. Some of the unique features are:

- A permanent motor rifle regiment (MR Regt)-sized opposition force (OPFOR) is established at the NTC. This force is trained in Soviet tactics, is equipped and organised as a Soviet unit, and fights according to Soviet doctrine. They are not a controlled enemy but are free players who have the advantage of an intimate knowledge of the terrain.

- A permanent, fully equipped team of observer controllers (OC) are established as direct support (DS) down to platoon level. They also provide a higher formation control and flank information input.
- All vehicles (including helicopters and aircraft) are equipped with Multiple Integrated Laser Effects System (MILES) so that the effect of battlefield fire is realistically portrayed. Similarly, each soldier has individual MILES equipment so that casualties and the need for reconstitution is a major battlefield problem.
- An electronic system of tracking combat vehicles to within 10 meters (m) anywhere on the battlefield is centrally controlled. The information is displayed in real time on an electronic screen and kept as a permanent record for immediate and very thorough after action debriefs.
- The NTC is a 50 mile x 40 mile manoeuvre area whose only restrictions are its terrain features.
- A very real determination exists in both players and controllers to produce the real effect of actions taken (whether good or bad).

Although the NTC is not designed specifically to test equipment, it is the prime training vehicle for mechanised combined arms training. It has become, in consequence, the proving ground for equipment in a battlefield environment. More significantly, it has become the testbed for developing the tactical doctrine and necessary techniques for integrating equipment into the all arms AirLand Battle. A perfect example of this is the use of ADSM.

The Weapon

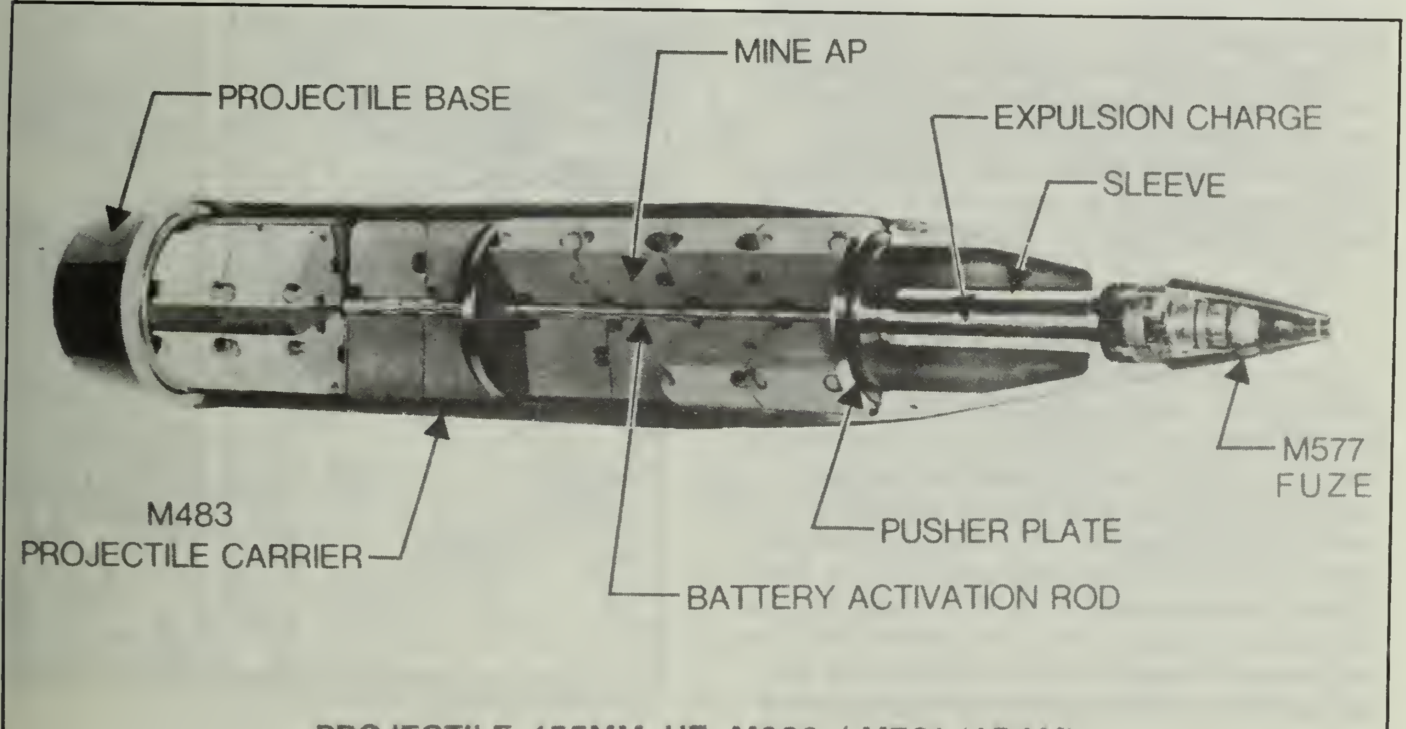
The rules of engagement for ADSM remain constant for each battle at NTC:

- Four low-density, two medium-density, or one high-density minefield are available.
- Only short delay fuses are used at brigade level, i.e., 5 hours to self-destruct. Longer length fuses are reserved for higher formations.

All ADSM fire missions must be authorized by division before firing. In practical terms this means that 10-12 minutes must be allowed to get divisional approval and a minimum of 7-10 minutes from firing until mines land and are armed on the ground (for a registered target).

The Players

On rotation 89-10, the 2nd Brigade Combat Team (BCT), part of 4th Infantry Division (Mech), deployed to NTC for 3 weeks, including 14 days continuous force-on-force manoeuvres in the field. The brigade consisted of two balanced task forces, each with two armor companies, two infantry companies, one engineer company, and one DS artillery battalion, plus brigade-level assets of a support battalion, chemical company (smoke and decontamination), military intelligence (MI), and air defence artillery (ADA) assets. Fixed-wing air, Army aviation, and division-level artillery were allocated for all battles depending on real availability and weather. The brigade commander, Col J. Dickey, is a very experienced brigade commander and veteran of



PROJECTILE, 155MM, HE, M692 / M731 (ADAM)

Photo courtesy of Honeywell, Incorporated several NTC deployments, including one as brigade commander. This deployment was typical and included four attacks, three movements to contact and two defence battles.

Planning-Effects

The physical effect of a scatterable minefield once it has been emplaced is the same as for a conventionally emplaced minefield, i.e., it will cause some casualties, will probably impose some delay (if only from forcing the enemy to carry out a battle drill or to avoid the area), and it may cause the enemy to turn or divert.

The criteria for an effective and successful minefield must be related to what it is designed to achieve. However, two elements are critical for success. Namely, that it must be covered by effective fire (either direct or observed indirect) and that it must be observed so that the fire can be effectively controlled.

ADSM minefields are unique in that they allow the tactical commander to do two things he was previously unable to do. First, he is able to produce an effective obstacle anywhere on the battlefield within artillery range without committing ground troops or exposing their dispositions or strengths. This allows the tactical commander to extend the range over which he can directly influence enemy movement. The ADSM will also increase the effectiveness of those weapons which can be brought to bear on the enemy at those ranges, e.g. close air support (CAS), attack helicopters, and artillery. Second, the weapon gives the tactical commander the ability to shape the battlefield in response to a changing or developing tactical situation.

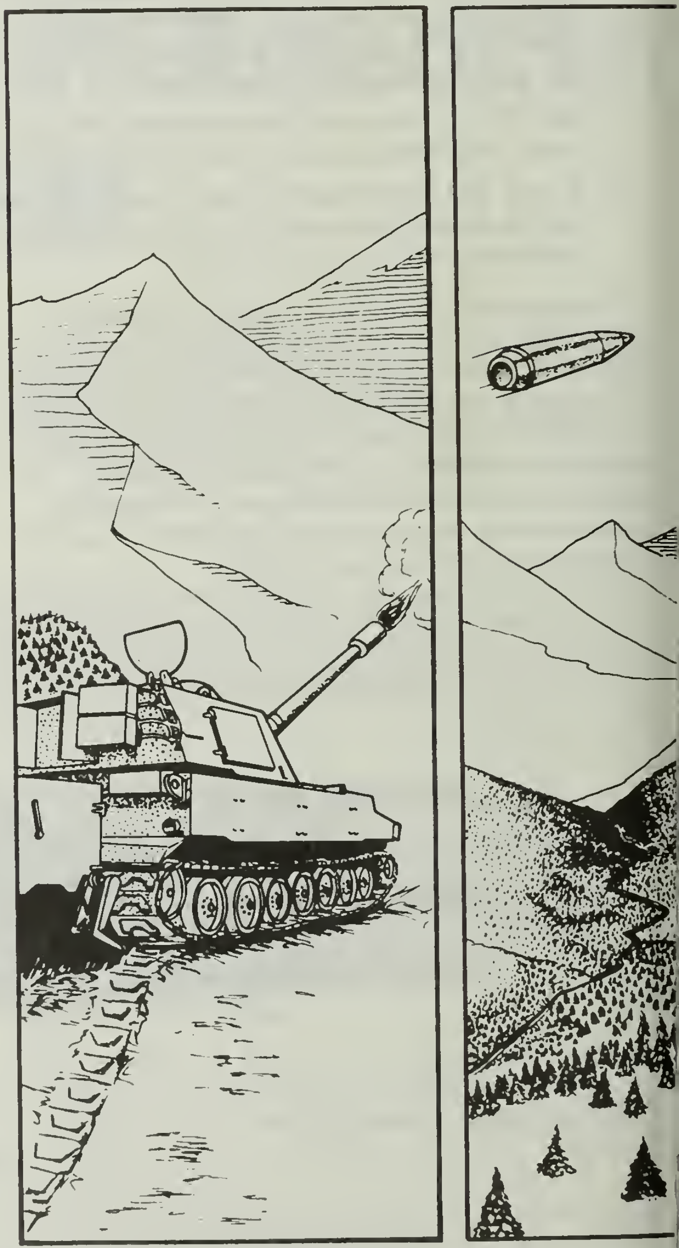
The combined effect of these two extra factors is that the tactical commander now has a number of new options available to him on how to fight the brigade deep battle. These, when coordinated with other assets, give him an opportunity to seize and retain the initiative from the enemy.

Planning-Options in Defence

In the brigade deep battle, that is, forward of the direct fire zone, engagement areas (EA) will have been identified and coordinated. The ADSM can be used as a combat multiplier either to delay an enemy force within the EAs and/or to deflect a moving enemy into them. The targets are thus concentrated and slowed, thereby enhancing the effect of those weapons targeted on the engagement area. Conventional obstacles may also achieve this if they are properly constructed and concealed. The advantage of the ADSM is that there is likely to be a number of EAs in the brigade area, and it allows the tactical commander to tailor his countermobility plan to the tactical situation while not prematurely obstructing his own mobility corridors.

ADSM can be used to orchestrate the battle to limit the number of enemy units with which the defenders are confronted. The aim is to achieve separation of the enemy's first and second echelon forces before they enter the direct fire zone. ADSM is thus used to disrupt the enemy's ability to mass.

Typically, a Soviet motorized rifle regiment will attack either three motor rifle battalions (MR Bns) in column, or two MR Bn up and one (the trail) 15-20 minutes behind. (The "trail" is ready to reinforce the more successful lead MR Bn.) In either case, the


Art courtesy of Honeywell, Incorporated

ADSM is targeted to separate the trail (or third MR Bn), allowing the defending ground forces to concentrate on the lead MR Bn. Other brigade-level assets, e.g., CAS, attack helicopters, or MRLS destroy the trail MR Bn. Thus, by denying the enemy the ability to reinforce quickly or to commit fresh troops to a weakened point, the defending force is given time to mount a counter penetration operation or to readjust their dispositions—in effect, to develop their own mass to meet the threat.

This has been one of the most effective uses of ADSM at the NTC, where even a seemingly insignificant delay of 5-10 minutes has been the decisive difference between success and failure of a defensive battle.

In the direct fire zone, the ADSM may equally be employed to delay and disrupt an enemy force in the direct fire weapon killing areas. It could also be used to enhance the obstacle plan which shapes that area. (This may have to be done as an expedient measure if there has been insufficient time or resources to complete the obstacle plan, or if it has been ill-conceived and gaps have been left.) It is more effective to use ADSM to reestablish obstacles which have been breached or to use it in conjunction with a preplanned counter-penetration task. The complications of how these are best controlled and by whom on a confined and confused battlefield will be addressed later.

When moving a force of any size, an ADSM plan to

target likely enemy avenues of approach into an exposed flank is both sensible and obvious. However, the options for using ADSM in offensive operations are even more diverse than in defensive operations.

In a meeting engagement scenario, ADSM can be used initially to fix in position the enemy lead elements. Subsequently, ADSM can be targeted to enhance natural terrain features, e.g., an impassable ridge, thereby allowing mechanised infantry to establish a hasty defence to restrict the enemy's ability to conduct a flanking movement. The ability to do this quickly requires very slick battle procedure. A decisive commander with a clear battle picture combined with the artillery's ability to deliver the mines accurately and quickly is essential. Limiting your own freedom of movement is a danger in a rapidly changing situation.

In an attack, the ADSM should be used to restrict the enemy's ability to mass by preventing him from repositioning, i.e., by firing the ADSM on top of his known static locations or by selecting a suitable choke point through or round which he must pass. Clearly, the prime target in attack is the enemy counter-attack force, which will probably also be the priority target in attack for other brigade assets, such as army aviation or fixed-wing assets.

Often the enemy tactic is to use hide positions and only occupy prepared positions at the last moment (to avoid the artillery preparatory fire). When this is the case, two additional options are open. The first is to target the hide positions if they can be identified. The second is to target the prepared positions to prevent reoccupation. Either course will be influenced by the need for friendly forces to use the same ground and by the quality of intelligence information available. It is possible to time the ADSM to self-destruct before friendly forces arrive on the target.

The list of options given is not exhaustive, but it illustrates that a clear understanding of the weapon's capabilities is needed if the unique qualities are to be utilized.

Essentials For Success

Concept. The ADSM plan must have a clearly defined aim and be designed to support the overall concept of operations. At brigade level there are likely to be several contingencies dependent on the enemy threat. The ADSM plan must be capable of a quick and flexible response.

Targets. The ability to respond flexibly means that many more targets must be planned than can be fired. Routinely at the NTC this meant about 20-24 targets per mission, although a maximum of four ADSM targets are authorised. It is also possible to shape the target to suit the ground, e.g., 800m x 200m centred on grid 123456 oriented north-south, although at the NTC a standard 400 x 400 square minefield was used for control simplicity.

Time. The planning time to obtain release authority from division is approximately 10-12 minutes, while the lead time from firing until the mines have landed and armed is approximately 7-10 minutes for registered targets. There is, therefore, a clear requirement for an intelligence trigger if the ADSM is to be in position in time to affect the immediate battle. The circumstances needed to trigger individual targets must be defined.

Triggers. The circumstances (triggers) which cause an ADSM mission to be fired are worked out according to three factors:

- A straight time/distance calculation, based on the location of the target and the best speed of the enemy moving towards it.
- The projected enemy decision points, which are either terrain related, e.g., when he has to commit himself to a particular avenue of approach, or event related, e.g., when the enemy has to commit his trail MR Bn to reinforce one of the lead MR Bns.
- Enemy action may force our own troops to a particular course of action for which planned ADSM targets may be detrimental. A comparatively simple decision support matrix format is used for control and to keep all players informed (see chart at right).

Intelligence. The receipt of the necessary battle information or intelligence assessments is, therefore, crucial if the ADSM is to be fired in time. The solution to the problem depends on gearing the intelligence collection plan to provide the necessary information for ADSM triggers. In practical terms, this is a major coordination effort that includes specific taskings for reconnaissance assets on the ground, and utilizing longer range assets, e.g., fixed wing, army aviation, direct fire assets, etc.

Equally vital sources of information are division and flank formations. (Often enemy decision points and friendly trigger lines lay outside the brigade boundaries.) Similarly, it is often possible for division assets to confirm battlefield reports or vice versa. The whole process also has the effect of focusing the division intelligence system on the information that is critical to the brigade plan. It also helps the rapid release of firing authority.

Assets. When the decision to fire ADSM has been made, execution still depends on three factors:

- That the artillery and ammunition are still available, i.e., they have not been destroyed or were on the move.

Scatterable Mine (FASCAM) Decision Matrix Example

Target number	Location	Aim	Trigger	Trigger Location	Division Clearance	Priority	Remarks
DB0001	398118	Separate trail motorised rifle battalion from lead MR Bn	1. Enemy committed to southern approach 2. Enemy trail MR Bn committed to southern approach 3. Enemy lead MR Bn reaches target location	Easting 44Sth of Northing 14 passing hill 876	With effect from 10 June 0500 Fired at	1	Low density minefield; coordinated with Aviation Liaison Officer for attack helicopters from attack position Charlie
DB0002	298153	Delay enemy in southern pass defile	1. Enemy committed to southern pass at decision point 4 track junction 339140	Easting 34N of Northing 12	Not yet given	3	Low density minefield 800 x 200 N - S
See note 1		See note 2		See note 3	See note 4		

Notes:

1. Standard 4th Infantry Division target numbers.
2. This defines the intent of minefield. There may be several different sets of circumstances which will trigger the FASCAM. Equally, the minefield may meet several aims which would be defined separately.
3. The trigger point ideally should be related to a terrain feature to assist the observer asset tasked to oversee it.
4. The authority release time, the time the decision to fire was made, and the time the FASCAM was in place.

- That authority for release has been obtained from division.
- That the priority of fire has been given to the ADSM mission. In practical terms, to fire two low- or one medium-density minefield means being without a 3 x 8 artillery battalion for approximately 4-5 minutes, not counting the subsequent movement.

Effectiveness. In order for the ADSM minefield to have the maximum effect it, like any other obstacle, must be covered by fire. In the case of the brigade deep battle, this means coordination of other assets, e.g., artillery, attack helicopters or CAS, together with the surveillance assets to direct them on the target. Equally important is to report their effect on enemy movement and the number of casualties. Orchestrating the types of fire to complement the ADSM and increase its effect is also possible. For example, conventional artillery fired on an enemy moving in columns in front of a minefield causes the enemy to disperse into battle formation. This causes them to incur more casualties from the mines. Similarly, the OPFOR tend to reform into columns after passing through a minefield when conventional fire is again more effective.

Clearly, the quantity and detail of coordination necessary from all elements of the staff as well as those engaged on the battlefield is considerable. The planning sequence and responsibilities are outlined below.

Level of Control

Control is best retained at brigade level. ADSM has most influence when it is used as part of the brigade deep battle and in conjunction with brigade-controlled fire assets throughout the whole brigade area. It is most effective when used on brigade level tasks, such as separating the enemy echelons, preventing his repositioning or by delaying his counterattack force.

Speed of reaction to the enemy situation or in obtaining release authority is critical if the ADSM is to be fired in time. The brigade headquarters is the focus for the intelligence collection plan, and with the best communications to division can keep delays to a minimum.

Conversely, delegating the control of ADSM to the battle group level only produces a problem for the brigade commander. He has neither the intelligence assets, time, nor communications necessary to anticipate when ADSM is to be fired to be effective. The temptation is to fire ADSM before battle is really joined to avoid "losing" indirect fire assets at a critical time.

Similarly, delegation of control requires a commitment to one or other of the battle groups. Hence, the flexibility of response to the enemy action is lost or at least complicated. The NTC experience is that even when ADSM targets are fired in the direct fire zone, they are best fired by the brigade in direct support of the battle group action rather than controlled by the battle groups themselves.

Planning Sequence

Initial staff work on receipt of mission. In addition to the normal brigade engineer officer (BEO) input into the Intelligence Preparation of the Battlefield (IPB) by the brigade S-2 (intelligence officer) such as terrain analysis, battlefield obstacle update, and likely enemy engineer courses of action, the BEO identifies terrain suitable for ADSM targets. It may be necessary at this stage to tailor target shape and orientation of ADSM to ensure the minefields on the ground are effective, e.g., extended across the whole width of a defile.

At the same time, the BEO and fire support officer (Arty Ops) must confirm what ADSM has been allocated and what restrictions apply, e.g., release authority, available fuses, or which artillery is to execute the missions (this may impose a range restriction).

Tactical commander's outline concept. Based on the IPB, which includes the templated enemy positions and his possible courses of action according to doctrine, the tactical commander decides on the brigade concept of operations for each eventuality. As part of that process, the overall aim and possible uses for ADSM are identified. The crucial elements are to clearly identify what effect on the enemy the ADSM is designed to achieve and to establish which circumstances are to trigger the decision to fire ADSM.

This process allows the BEO to produce a combined target list and decision support matrix. This is the basis for the control of the ADSM during the battle. It contains not just locations, type and shape of the ADSM targets, but also the decision criteria and triggers for each one. The ADSM decision support matrix is included in the brigade order in parallel with the brigade obstacle plan with which it has been coordinated.

Subsequent staff actions and coordination. The decision support matrix is used by the brigade S-2 to identify priority intelligence requirement (PIR) and to incorporate them into the intelligence collection plan tasking brigade and battle group assets accordingly. Similarly the PIR are passed to the division and flank formations via the intelligence net. The FSO (Arty Ops) uses the matrix to register targets in the digital tacfire systems. It is often possible to checkfire and adjust the targets and thereby to rehearse and prove both the artillery execution and the reconnaissance/surveillance assets tasked to oversee them. In defence, the registration can be done by the artillery target surveyor system (PADS) to keep the target location secure. Other artillery targets are planned in conjunction with the ADSM to complement it. Artillery problems can also be identified at this stage, e.g., for a movement to contact, artillery assets sometimes have to be moved forward early to provide the necessary range.

The BEO passes the ADSM plan to both the division engineer and the division G-3 (operations), requesting release authority from the latter for the top priority targets. This is sometimes given early although usually with some qualification, e.g., release given from 30 minutes prior to line of departure time (H hour).

The battle group commanders, after a similar initial planning sequence at the lower level, may identify further ADSM targets to support the close contact battle, or seek adjustments to the brigade target list. These are agreed and are incorporated into the brigade decision support matrix rather than be a separate list. For each new target or adjustment to the list, all the staff actions have to take place. This takes considerable time and effort.

Further coordination with the air liaison officer (ALO) and the aviation LO is needed to preplan how those assets will be orchestrated and controlled on the battlefield to make maximum use of the opportunity ADSM provides. This is part of the overall coordination of fire plan when detailed control arrangements and priorities of fire and of targets are coordinated.

The final function to be performed, which is crucial to achieving success, is a full staff rehearsal of the plan. This staff rehearsal on a large-scale sand model is a brigade staff prebattle SOP for the whole battle. It is the means whereby all those who will be or could become involved in fighting the battle are fully informed and made to understand the concepts and priorities of the battle, and how it is to be executed and controlled. It includes not only all principle staff but the ALO, attack helicopter LO, air battle captain, and those who will be running the battle rom the TOC (main HQ), jump TOC (alternate HQ), and tac HQ. The rehearsal does not necessarily include subordinate commanders, although they are desirable. The rehearsal often exposes shortfalls and the need for further coordination. It is also used as the vehicle to design some redundancy into the plan particularly in communication aspects.

Battle Fighting

The long, involved and time-consuming planning nd coordination process is proved justified when he battle is fought. It clarifies the responsibility of he principle staff, who are therefore better able to nticipate requirements and react quickly. The esponsibilities are:

The brigade commander, or XO, fights the battle nd makes all executive decisions either to fire or to hange the priority of ADSM targets.

The brigade S-2 (intelligence officer) coordinates he information from all agencies plotted on the perations map and from which he produces his asessment of enemy intentions.

The FSO (Arty Ops) executes the ADSM and eeps the brigade staff updated on likely reaction me if the executive order is given.

The BEO is the overall coordinator of the ADSM attle. This involves correlating all the intelligence inrmation with the ADSM decision support matrix nd recommending to the commander which targets nould have priority and what the trigger events are. e is also able to assess how much time is available to make the decision. When changes are eeded, which is often, the BEO obtains release uthority from division, warns the other staff, e.g., SO, ALO and aviation, and passes the scatterable ine warning report up to division.

Once the executive order is given to fire the DSM, the BEO ensures that it is properly recorded nd reported. An accurate report on its effect is ten difficult to obtain in a confused battle, however. he reporting is critical to maintain an accurate bate map, and to record when short time delay selfestruct fuses have been fired.

The distribution of responsibility serves two other portant functions besides ensuring that the ADSM used effectively. First, it allows the battle comander to concentrate on making decisions while eing sure he is being fed the right information to be ble to react in time. Second, it ensures that the enneer has a real and crucial part to play in fighting e battle, often carrying out functions which are ually S-3 (Operations) actions. This serves to lieve the pressure on the operations staff at critical nes in the battle.

Summary

The main points are:

- Artillery delivered scatterable mines (ADSM) can be a decisive battle-winning factor in both offence and defence.
- ADSM are most effective when used in the brigade deep battle, where they can allow the tactical commander to seize and retain the initiative.
- ADSM must be used to support the overall concept of operations and are most effective when used to disrupt the enemy's ability to mass.
- Their use must be planned and controlled at brigade level, where a specific member of the brigade staff should be responsible for overall coordination of planning and control during battle.
- Firing scatterable mines in response to enemy action requires significant lead time. Clear trigger lines and decision criteria must be identified in the plan and integrated into the intelligence collection plan using all available assets if these lead lines are to be met. The decision support matrix is a simple, well proven technique to assist in this process.
- It is insufficient to regard ADSM as a weapon which can be pulled out and used if the right circumstances arise. It will simply not operate in time.

Conclusion

It is not possible to make detailed comparisons between the U.S. Army artillery delivered scatterable mine (ADSM) system and our MRLS 11. The weapons, organisations and philosophy of how to fight are very different. However, the fundamental employment options and the requirements for planning and control to use the weapons effectively are the same for both systems. A study of the proven American tactics and techniques is, therefore, relevant and should be studied and applied to the British organisation when developing our own tactical doctrine.

Major Peebles is a British engineer exchange officer assigned to the 4th Infantry Division, Fort Carson. His previous assignment was as an instructor at the United Kingdom Combined Arms Tactics Course. He is a graduate of the Royal Military Academy, Sandhurst, and holds a civil engineering degree from the Royal Military College of Science, Shrivenham.

MISPLACED COMPASSION

By Colonel Ron Dabbieri,
Chief, Combat Support Career Division,
Enlisted Personnel Management Directorate,
U.S. Total Army Personnel Command (PERSCOM)

A Speech Presented at the Signal Corps Association Regimental Dinner, Fort Gordon, Georgia, April 25, 1990

Over the next few years the Army will be faced with some significant leadership challenges. My intention here is to explain a philosophy as to how we, as leaders, should approach these challenges. A few years ago when I was commanding the 2d Engineer Battalion, 2d Infantry Division, in Korea, I had an executive officer named Major (now Lieutenant Colonel) Tom Tindall, who introduced me to the term "misplaced compassion." Since then I have run across the same concept termed "tough caring," among other things, and I have tried to apply it in my dealings with both situations and people. The best way to explain it is to use a couple of examples.

A good tactical example would be when a unit goes through MOPP training in chemical protective gear during the summer. Although it may become uncomfortable, unless troops are endangered by the training, being merely uncomfortable is not a reason to compromise the training. Because troops only do in combat what they have practiced in training, a leader who feels sorry for his troops and allows them to cheat and remove their protective masks in training is setting them up to do th same if they were to ever get into an actual chem cal environment.

Another good example is physical training. Not making troops get into shape during peacetime means they will not have the stamina to survive in combat. Is it not much more compassionate, more humane, to make them do the right thing in training so they will not die in combat?

Although it is very clear how misplaced compassion applies to training, it has a definite application in the personnel business, and I want to explain how all leaders should use this concept to guide their actions in dealing with subordinates.

Both the command sergeant major and sergeant first class promotion lists were recently released. As is always the case when a list is released, I was deluged with phone calls from soldiers asking "why wasn't I selected?" and from leaders (some with four stars) asking "why wasn't my main man selected?" Because I've been asked this question so many times during the two years I've been in PERSCOM, I have done some extensive research into what enlisted centralized selection boards look for in a selectee. I have thoroughly analyzed two years worth of after action reports prepared by each panel for branch proponents, interviewed members of nine promotion panels, and screened thousands of records of selectees and non-selectees. I feel that I have developed a fairly good understanding of what promotion boards for the branches I manage (Signal, Engineer, Aviation, Transportation, Military Police and Military Intelligence) are looking for. The most important attribute is outstanding performance in the tough TOE leadership positions.

The Attention Getter

Whenever I talk to leaders, especially officers, I get their attention by questioning how much interest they really have in their enisted soldiers. I do this by asking what the selection rates to major, lieutenant colonel, and colonel were this year. Almost every officer, even second ieutenants who don't have a prayer of being retained past their initial term of obligated service, can tell me within 2 percent the right answers. (Just for comparison it ranges from about 70 percent for major to 40 percent for colonel).

Then I ask what the selection rate was for sergeant first class for the list released in March 90, and I get blank stares. After I give the hint that a staff sergeant had a 42 percent greater selection chance this year than last I start getting guesses rom 60 percent to 80 percent. The real answer is his year the SFC selection rate soared up to 15.6 percent, which is 42 percent greater that it was last year when it was 11.2 percent. This year the selection rate to master sergeant was 17.1 percent, the highest it has been in years. Last year it was 12.7 percent. Today a staff sergeant has a less than 3 percent chance of ever making master sergeant!

With these low selection rates, boards are not only looking for outstanding NCO Evaluation Reports (NCOERs), they are looking at what the NCO was doing when he got the outstanding NCOER. They refer to jobs like platoon sergeant, first sergeant, and other TOE leadership jobs as being the "high risk-high payoff" positions. An NCO who wants to get promoted can't afford to sit back, he has to go out and aggressively seek those tough leadership jobs. Commanders and leaders also have an obligation to help worthy NCOs by putting them into those "high payoff" jobs. All too often, NCOs avoid these positions either because they are afraid of them due to their lack of previous leadership experience, or they are complacent and happy to let someone else do the tough jobs.

Why Me?

We all know NCOs who are delighted to spend many years behind the podium as a service school instructor, going home at 1600 hours every night. They can perform any mission, just so long as it is under environmentally controlled conditions—air conditioned in the summer, close to a heater in the winter, and within arm's reach of a coffee pot. Letting them stay there forever—is that true compassion? Yes, soldiers who do this are selecting themselves for non-selection. Yet, even though they know the end result is being "passed over" for promotion, these are the first guys to call me when the board results are released asking "why wasn't I selected?"

True compassion is to make these NCOs move to a location where the job they need for professional development is available, tell them what that job is, and encourage them to seek those tough leadership challenges. Many of these NCOs were simply afraid to try the TOE positions, but after being forced to, they do well. They just needed to mature into them. With the number of NCOs that have repetitive platoon sergeant tours back to back and done well in them, it is obvious that in most Career Management Fields (CMFs) there are more than enough to go around. Some NCOs feel comfortable doing them over and over again after they have gotten the first successful tour under their belt. Commanders and leaders need to show real compassion by encouraging all good NCOs to seek these "high risk-high payoff" positions and helping them develop into "promotable" leaders.

Chauffeurs vs. Leaders

Sometimes commanders and leaders are either selfish in using soldiers or don't understand the effect they have on the NCO's career by the jobs they keep them in. The best example of this occurred at 0730 hours on the morning the last SFC list was released. PERSCOM got two calls from two senior generals asking "why didn't my driver get selected?" With the short suspense I had, it was fortunate I had done an analysis of selection rates of VIP chauffeurs a few months earlier to provide professional development counselling for one of these same two NCOs. Both were primary zone SFC non-selects with excellent records, high GT scores, high school degrees, ANCOC graduates, and outstanding NCOERs—all with three-star or above raters. My analysis a few months earlier was that it would have been a miracle if either one of these two NCOs were to have ever been selected!

SFC promotion boards are asking the question "Do I want this NCO to be a platoon sergeant for me?" and if the answer is no, then the NCO is a non-select. In this case, these generals had been keeping these drivers with them as they went from assignment to assignment, or arranging for them to drive for other generals. Unfortunately, the members of the Transportation Promotion Panel do not recognize the "leadership" associated with driving a general officer, so they rarely select them for promotion.

Jobs and Careers

This does not mean that one tour as a VIP driver ends a career. I'm talking about the NCO who stays a driver and avoids the tough TOE leadership position. With a 15.6 percent selection rate, there are more than enough soldiers who have been truck platoon sergeants and maneuver support platoon sergeants to fill the quotas without selecting soldiers who have never served in a tactical leadership position. Misplaced compassion is helping that NCO avoid the tough job that might have allowed him to be selected.

Now, understand that the Transportation Corps is not alone in having jobs that must be done but that are less than career enhancing. MPs have accident investigators and dog handlers, and engineers have repair and utilities NCOs. And it doesn't help for anyone to work out of their MOS.

Sometimes commanders just must have a job done, but they need to realize the effect it has on the NCO's career. And they need to make sure that don't keep that soldier in that position for too long. If you don't have a supply sergeant and you absolutely have to put your 31Y commo chief in there to hold it together, recognize the fact that—even if you give him great NCOERs—he is still going to be hurt by it. Promotion boards promote people because of how well they perform in their own MOS, not in another one.

Another good example of misplaced compassion is when a commander or leader helps a subordinate get off an overseas assignment. First, it should be noted that selection boards view overseas service favorably. Soldiers who have performed their fair share of the tough overseas duty tend to have better career patterns, more varied assignments, more leadership experience, and higher selection rates. Selection panel members tell me they know what the turn around times are in their CMFs and it is obvious when someone has not done his fair share. When a soldier is selected for an overseas assignment, he is the most eligible to perform that duty. Overseas assignments must be filled, so when a soldier is deleted from the assignment, another less eligible soldier has to take his place, and he gets a lot less lead time. When leaders, believing they are being compassionate, help a soldier manipulate the system to avoid an overseas tour, they need to show a little compassion for the other poor soldier, who is less eligible, but who now has to replace the shirker.

The system is fair. If everyone takes his fair turn in the rotation for both long and short overseas tours to USAREUR, Korea, and Panama, then there will be a maximum turn around time for everyone. Commanders, do what is right and show compassion for all soldiers.

The Rush to Reclassify

Another phenomena occurs right after a promotion list is released: the number of soldiers who clamor to reclassify, and the number of commanders who blindly sign the recommendation for approval on the DA Form 4187, without even talking to the soldier. First, understand that in many cases reclassifying out of a grossly overstrength dead-end MOS is a good career move, but the soldier needs to be smart about it.

My research shows that very few NCOs, staff sergeant and above, who reclassify out of their CMF, and especially out of their branch, ever get promoted. I have questioned panel members why this occurs. I've been told that there is no bias against them, but when an NCO reclassifies, he gets Skill Level 1 training and maybe BNCOC if he is lucky. Then he is expected to supervise soldiers who have been in the MOS for years. This can be a "mission impossible," and normally their first few NCOERs are not good. With the low selection rates, you don't need too many mediocre NCOERs to be non-competitive. Also, selection boards have more than enough "home grown," in-the-branch NCOs with outstanding records to fill all the promotion quotas without looking for opportunists who came into the branch late in life.

As a battalion commander, if your XO came in to see you about a branch transfer to be a dietitian because they had a 100 percent selection rate to LTC this year and your branch didn't do as well, wouldn't you set him down and counsel him? Wouldn't you say to him "Look, you've been a platoon leader, company commander, and now a battalion XO in this branch, what do you know about being a dietitian? Yes, they had a good selection rate but they're not going to select you!"

Instead of giving your NCO the instant gratification of approving his request, don't you owe it to him to counsel him so that he makes the right decision? My advice is to stay in the same branch where there is a great deal of transferability of skill, and the members of the promotion boards have been members of your branch all along.

"Not in my Army!"

Another area where I see many instances of misplaced compassion is mandatory reclassification actions where an NCO has lost qualification for an MOS through his own misconduct. A security clearance is required to hold many MOSs, especially in the Signal Corps, Military Intelligence, and Military Police branches. I have seen numerous instances where an NCO has committed repeated acts of misconduct, in many cases without any disciplinary action being taken, and the commander simply wants me to move the individual out of his branch. The attitude seems to be "this NCO is good enough to be in the Army—just not my Army!"

If it's possible, I leave the individual in the MOS and return the action back to the commander to reevaluate the NCO's retention potential. PERSCOM mandatory reclassification rules leave the soldier in the same CMF or branch if possible, then he stays in the same category (Combat Arms, Combat Support, Combat Service Support). In these circumstances, if I could, I would enter this substandard individual (along with the commander who wants to keep him in the Army) into the Married Army Couples Program so they could be together for the rest of their careers. The problem is, if we do retain one of these soldiers on active duty, some other branch has to take him and he blocks a promotion for some other good soldier who has paid his dues in the MOS—and that is *not* fair.

Commanders, when you have a soldier who must be reclassified because of his own misconduct, take care of your own dirty linen and don't just shuffle your problem off to another branch. This is truly the definition of misplaced compassion, when you show compassion for a substandard NCO. You don't want him in your branch or unit, yet you allow him to continue to take up space and stripes in our Army that rightfully belong to a good and deserving soldier. Here, what we need is a little compassion for the other soldiers that this guy is holding back—or the soldiers being subjected to this NCO's substandard leadership.

If you have been reading the Army Times, you know about as much as anybody about Army force structure and strength reductions in the years to come. We have already begun to draw down forces and inactivate units at Fort Lewis and Fort Knox, and are planning for reductions at Fort Hood.

Tomorrow's Army

The future size of the Army will be influenced by national strategy, the changing threat, and the budget. The strength of the Army will be adjusted to keep authorizations and inventory in sync. The number most commonly quoted is about a 580,000 soldier Army by FY 96/97. This would mean about a 35,000 loss every year between now and then. The Chief of Staff guidance has been not to sacrifice readiness and, as a matter of fact, he expects readiness to improve. Some things to consider—today's Army is built on volunteers, they are quality soldiers not eager to leave the service. This is not a demobilization exercise like after our wars where people were eager to get back to civilian life.

Given this, the personnel principles we will be guided by are:

- ▶ Protect quality
- ▶ Care and compassion
- ▶ Shape the force for the future
- ▶ Common sense
- ▶ Sustain readiness

So what have we already done in FY 90?

- Reduced by 18,000 the number of new accessions into the Army.
- Reduced MACOM first term reenlistment missions from 34,400 to 27,000.
- As of April 1, 1990, greatly reduced reenlistment options. Career soldiers with 10 years or more time in service can reenlist Regular Army or leave service. Several other options have also been greatly reduced.
- Curtailed Selective Reenlistment Bonuses (SRBs) to cover only the most critical MOSs.
- This year an estimated 1100 substandard NCOs will be eliminated as a result of Qualitative Management Program (QMP) actions. The zone of QMP consideration for the July 1990 master sergeant board will include all sergeants first class with one year time in grade. Previously, only those NCOs in the zone of consideration for promotion were scrutinized.
- Granted commanders authority to separate early those soldiers barred from reenlistment, if they volunteer for such action and the commander feels the soldier is not capable of overcoming the bar. Here, it is incumbent upon the commander to counsel the soldier on the merits of cutting his losses and starting over as a civilian rather than hanging around until ETS.
- Provided authority to separate soldiers up to 90 days prior to normal ETS. We are seeking authority to separate soldiers up to one year early in units affected by reductions, who do not intend to reenlist, provided there are no loss of benefits.
- Internal to PERSCOM, liberalized standards for approving "exception to policy" retirements. The two year lock-in for promotion is routinely waived for soldiers who want to retire immediately rather than accept an overseas assignment. A warning here is that you must submit immediately and retire as soon as you reach 20 years service. Don't expect to be allowed to decline an unaccompanied assignment and then, six months after you come down on instructions, be allowed to submit your retirement.

And what do I see coming up in FY 91 and beyond?

- Continued reductions in accessions.
- Continued early separations for substandard soldiers (bars and QMP).
- Possible reductions in reenlistment control points (RCP).

I can't provide any guarantees, but it is the Army's position to do everything possible to avoid an enlisted reduction in force (RIF).

As commanders and leaders—what can you do to help?

Be selective in reenlisting soldiers. Go for the quality. Remember, if you allow a less-than-quality soldier to reenlist today, he may displace a good soldier who we won't have room for tomorrow.

When a soldier commits an act of misconduct that requires you to revoke his security clearance—take a hard look at him. Don't just hand him off to another branch by reclassifying him. Do the right thing even if it means separating him.

Straight Talk

Be frank and honest with your soldiers when you counsel them. As a commander you can tell when a soldier does not have the potential to complete a successful career. Tell that soldier to cut his losses early and get out. It is much more compassionate and humane for that individual to get a new start as a civilian after a first term of service than to invest 12 or 15 years in service only to be QMP'd or separated. It is also much more compassionate for other soldiers so that they are not subjected to substandard leadership from an inferior NCO. It also clears the way for more capable junior leaders to be promoted.

In closing, I would like to relate this all back to compassion. A really compassionate leader cares for his subordinates, he makes them do the tough things that prepares them for promotion, and he is frank with them in providing the very best advice he can. It may not be what they want to hear but is always what they need to hear.

When a commander or leader does the right thing morally and ethically, invariably it is the right thing for the Army and the right thing for the soldier. The soldier just may not know it at the time.

Colonel Dabbieri is an engineer officer and former enlisted soldier. Commissioned from Engineer OCS, he served in Vietnam and has commanded fou companies. He served as the executive officer of th 19th Engineer Battalion, 194th Armor Brigade and commanded the 2d Engineer Battalion, 2d Infantry Division, in Korea. He is a graduate of Command and General Staff College and the Nationa War College.

LESSONS LEARNED

By Captain Neal T. Lovell, DOES

This column concentrates on Honduras, where several Army engineer units have been involved in humanitarian construction projects over the past several years. It is a sample of the information available upon request from the Engineer School. For more information write to: Commandant, U.S. Army Engineer School, ATTN: ATSEESAL, Fort Leonard Wood, MO 65473-6630

ISSUE: Effects of lime slurry on 6000-gallon water distributors.

DISCUSSION: Prior to deployment, commercially available lime slurry distributors were planned for use in lime slurry operations. Several vendors were located and lease prices were obtained, but the costs submitted to the brigade S-4 were determined excessive. Also, some vendors did not want to bid on the lease of single distributors, they wanted to lease a package of equipment. The only other distributors available on short notice were organic 6000-gallon water distributors that belonged to another engineer battalion. The decision was made to use them.

RECOMMENDATION: Ensure funds for future projects that require lime stabilization are sufficient to include the lease of suitable commercially available distributors and that adequate lead time is provided for procurement.

ENGINEER SCHOOL COMMENTS: There is no on-going action to procure distributors made specifcally for lime slurry operations. Several sizes of water distributors suitable for lime slurry operations are available in the supply system. However, users must clean the equipment thoroughly after use.

ISSUE: Mix of vehicles used for a task force support battalion's (TFSB) transportation fleet.

DISCUSSION: The TFSB deployed with ten M923 5-ton cargo trucks and six M931 tactical tractors that would be used as a line haul transportation fleet. The vehicles were required to travel on mountainous terrain with many hairpin curves. Portions of the route between San Lorenzo and Sato Cano, Honduras, are in disrepair and would be considered off-road conditions in the U.S. The M931 tactical tractors were selected because they can be driven off-road. It was difficult for the M923 5-ton cargo trucks to travel down steep grades at safe speeds. Because both vehicles have diesel engines and semiautomatic transmissions, drivers could not effectively use downshifting to slow their speed. The only way to keep vehicles within prescribed limits was to ride the brakes. This action caused the brakes to overheat and "glaze," requiring extensive maintenance after each convoy.

RECOMMENDATION: Deploy six M915 tractors in addition to the six M931 tractors. The M915s have a "retarder" that can slow the vehicle without riding the brakes. Use the M915s for line haul assets and the M931s for local off-road runs.

ISSUE: Construction of tent floors.

DISCUSSION: Original base camp construction plans called for using 4' X 8' prefabricated tent pads to construct tent floors. Only one-half of the required tent pads could be contracted out due to dollar ceilings. Construction of the rest was time consuming because it required cutting and nailing lumber.

RECOMMENDATION: Prefabricated tent pads are expensive and unnecessary. The following alternate method eliminates the need for cutting wood or nailing boards together, and it eliminates waste when teardown occurs. The method uses 2' X 4' lumber placed (wide side down) along the tent sides and down the center. Then 1' X 6' or 1' X 8' lumber is laid on top of the 2' X 4's to form a satisfactory floor.

ISSUE: Threat

DISCUSSION: The greatest threat to the task force was, as predicted, theft and population control. Local Hondurans, including children, vendors, thieves, and prostitutes, continually surrounded the base camps, work sites, and equipment parks. Some of them looked for opportunities to steal or sell their wares to soldiers. The situation was complicated by friendly soldiers, who encouraged the sale of sodas, goods, fruit and sex. Because of this activity, safety became a major concern for both Hondurans and U.S. soldiers.

RECOMMENDATION: The key to population control is command involvement, soldier discipline, and physical barriers. Commanders and first-line supervisors must make soldiers aware of the threat and discipline them early in the deployment. Soldiers must not give handouts to local citizens because this practice encourages the problem. Use the chaplain's office or the public affairs office to operate any programs that donate items to the local populous.

ISSUE: Use of Honduran guards

DISCUSSION: It was necessary to use Hondurans as guards, and one task force employed between 10 and 43 guards at any time. Breakdown of security for the different phases of operations included port operations, base camp development/teardown, and construction. Guard requirements changed for each phase. Because the exercise encompassed a large area of operation, the requirement for Honduran guards was large. During ship on/off load, 10 Honduran guards were employed with an equal number of U.S. guards at the vehicle marshalling area. Ideally, the ratio of Honduran to U.S. guards should be 1:1 to ensure overlap and joint HO/US participation. Guard requirements for base camp development/teardown rose and fell, depending on the size of the U.S. force.

Most of the Honduran guards came from the 11th Infantry Battalion (HO), although a few came from the 101st Infantry Brigade. These soldiers were very young, 14 - 19 years old, inexperienced, and had little education. All Honduran guards had one NCO with them at all times. At night, they were alert and extremely sensitive to movements near the perimeter. They did not hesitate to fire warning shots or bodily apprehend intruders. Also, they did not adhere to JTF-B rules of engagement, but took instructions from their Honduran commander.

RECOMMENDATION: Use Honduran guards as much as possible, but be realistic in your requirements. Local Honduran units may not be able to meet the total guard requirement, so establish priorities and coordinate with the Honduran commander and S-3 prior to deployment. Honduran soldiers appreciate the opportunity to be with U.S. forces.

ISSUE: Delivery of construction materials.

DISCUSSION: Contractors delivering construction materials were directed to one of two base camps, depending on the project materials they had. Strict control of materials became difficult because there was confusion about which materials went where, and some deliveries contained material for projects at both base camps. The haste to off-load complicated the problem. In an attempt to correct the problem, the task force S-4 directed that all material be delivered to one location.

RECOMMENDATION: If the task force (TF) is composed of more than one battalion (i.e., controlled by a group or brigade), establish a central Class IV receipt and issue yard. Require subordinate units to augment the TF or brigade S-4 staff section with stock control personnel.

ISSUE: Poor quality of contractors and construction material.

DISCUSSION: Failure of contractors to meet required delivery dates and poor quality of construction materials created delays in project starts and completions. Delivery of construction materials such as base-camp lumber, gravel, culverts and sand was difficult. Most of the materials were ordered through the JTF-B contracting office well in advance. However, many of the Honduran contractors failed to meet their scheduled delivery date or provide the required quantity of materials.

RECOMMENDATION: Establish a list of reliable contractors for construction materials. The unit must request construction materials for projects early in the planning cycle to allow for receipt by the JTF-B Class IV yard (DCSENG) at least two months prior to STARTEX. In addition, each bill of materials must be identified by project number.

ISSUE: Number and type of vehicles deployed as line haul assets.

DISCUSSION: The TFSB deployed with ten M923 5-ton cargo trucks and six M931 tactical tractors, which would be used as the line haul transportation fleet. The TFSB was forced to augment them with unit organic vehicles at the rate of three 5-ton tractors per day for a 2-week period. The requirement to transport rations, lumber, concertina, and major assemblies far exceeded the TFSB's capability during this time. In the redeployment phase, the organic vehicles were not available to augment the transportation fleet because they had already passed customs inspection. The unit could not afford the loss of these vehicles during redeployment.

RECOMMENDATION: The transportation fleet for a battalion-plus sized TF should consist of six M931 tractors, six M915 tractors, ten M871 trailers, four M874 trailers, and ten M923 cargo trucks.

ENGINEER UPDATE

Directorate of Training and Doctrine (DOTD)

ARTEP 5-145-11-DRILL, "Engineer Battle and Crew Drills," scheduled. ARTEP 5-145-11-DRILL is scheduled for printing in the 4th quarter of FY 1990. This manual describes the most common engineer battle and crew drills for all types of engineer organizations. Battle drills, designed for platoons and smaller elements, are collective actions executed without a deliberate decision-making process. Crew drills are a form of battle drill designed for crews or specific items of equipment (AVLB or CEV). Each engineer organization will choose the battle and/or crew drills that support their METL. POC is CPT James Glass, (314) 563-7784.

Department of Military Engineering (DME)

Scatterable Mine Information Declassified. The self-destruct (SD) times and the safe separation and arming (S&A) times for U.S. scatterable mines have been declassified. For U.S. scatterable mines the self-destruct times are:

Scatterable System	Self-Destruct Times			
	4 Hours	48 Hours	5 Days	15 Days
ADAM/RAAMS (M731/M741)	X			
ADAM/RAAMS (M692/M718)		X		
GEMSS (M74/M75)			X	X
MOPMS (M76/M77)	X			
GATOR/VOLCANO (M89/M90)	X	X		X

Mines will start to self-destruct at 80 percent of their SD time. When the full SD period is reached, no mines will remain. Mines with a 4-hour SD time will start to self-destruct at 3 hours and 12 minutes. When the 4-hour self-destruct period is reached, no unexploded mines should exist. The probability of a live mine existing past its SD time is 1 in 1000.

Although most U.S. scatterable mines have an S&A time of 2 minutes, the S&A time is 45 minutes for GEMMS mines and 90 seconds for MOPMS. An on-going product improvement program will reduce the S&A time of ADAM/RAAMS mines from 2 minutes to 45 seconds. During the S&A time period, the mines conduct a self-test. If a mine fails the self-test, it will self-destruct at the arming time. VOLCANO mines self-destruct at the S&A time (2 minutes) at a rate of 13 per 1000. POC is CAPT Joe Jenkins, (314) 563-5595.

Medium Girder Bridge (MGB) Upgraded. The MGB has been approved for MLC 70 in the following configurations:

Bridge configuration	MLC	Bridge length meters (feet)	Max transverse slope unloaded
Single Story	60 70 (T) 100 (W)	9.8 (32) 9.8 (32) 9.8 (32)	1/10 1/20 0
Double Story	60 70 (T) 100 (W)	32.9 (108) 31.1 (102) 27.4 (90)	1/20 1/20 0
Double Story Link Reinforced	60 70 (T) 100 (W)	49.4 (162) 45.7 (150) (Note 2)	1/20 1/20 0

Note 1 - For MLC 70 tracked (T) and MLC 100 wheeled (W) configurations, the bridge width should be shown on a sign, as shown in STANAG 2010.

Note 2 - MLC 100(W) span has not yet been confirmed by tests. POC is Joe Cowgill, (314) 563-5835.

Information For Short-of-war Manual Requested. Your ideas anc experiences are needed for a manual tentatively titled, "Engineers ir Operations Short of War." Topics will include engineer support ir deployments, military construction, peacekeeping operations, counterterrorism, mobile training teams, disaster relief, counterdrug operations, and nation assistance. A coordinating draft is planned for fielding in 4th quarter, FY 1990. POC is CPT Doug Houck, (314) 563-5671.

Team Leaders Sought for Engineer Officer Advanced Cours (EOAC). Are you looking for a continuing challenge after a successful tour as company commander? Come to Fort Leonard Wood an be a team leader for the EOAC. As a team leader, you are responsible for the training, coaching, and total fitness programs for 12-1 EOAC students. They include Army (Active, National Guard, an Reserves), Marine Corps, and International officers. Your primar roles include small group instructor, facilitator, counselor, tear leader, subject matter expert, and role model for the officer student We want to make the Engineer School the best leader trainin facility in TRADOC. If interested, contact your captains' assignmer officer at Headquarters, DA, and let your desires be known. POC i LTC Lloyd Evans, AV 676-5754 or (314) 563-5754.

Directorate of Combat Developments (DCD)

Reforger 90 Concept Evaluation Program (CEP). The TRADO Test and Experimentation Command (TEXCOM) conducted a CE during the REFORGER 90, Centurion Shield exercise to assess th division engineer (DIVENG, formerly E-FORCE) force structur Results of the CEP demonstrated significant improvement in cor mand and control, maneuver force combat effectiveness, and corp flexibility. A report describing results will be fielded in June 1990.

TRADOC Analysis Command (TRAC) Completes Engineer Structure Study. A study to compare three engineer force structure alternatives against current engineer force design was completed in June 1990. The study used several analytic tools, including spreadsheet performance analysis, command and control computer modeling, and force effectiveness computer modeling. Results show significant improvement in corps warfighting capability when using the DIVENG force structure. A report describing results is scheduled for distribution in July 1990. POC is Vern Lowrey, (314) 563-7885.

Automatic Integrated Survey Instrument (AISI) Update. The AISI is an electronic total station that integrates functions currently performed by theodolites and distance measuring equipment into a single, state-of-the-science device. Suitable for both office support and field work, it is rugged and man-portable, with speeds matching AirLand Battle requirements. The instrument will be used by construction (82B) and topographic surveyors (82D). Fielding is planned for 1992 and 1993. POC is Merrill Stevens, (314) 563-7209.

Department of Combined Arms (DCA)

Field Manual Update. The following field manuals (FM) are in the final stages of production. FM 90-13, *River Crossing,* and a coordinating draft of FM 5-X, *Combat Engineer Company Operations,* are scheduled for printing in the 4th quarter of FY 1990. FM 90-13-1, *Combined Arms Breaching Operations,* is scheduled for printing in the 1st quarter of FY 1991. These manuals will provide a common thread through all levels of training, from the Basic Noncommissioned Officer Course through the Pre-Command Course. POC is Herman Kufura, (314) 563-5449.

Department of Topographic Engineering (DTE)

Digital Terrain Analysis Programs Demonstrated. The Earth and Space Division recently demonstrated current and future digital terrain analysis capabilities at the Armor, Engineer, and Infantry Commanders' Conferences. Two Army-developed software packages were included: Terrabase provides warfighting commanders with quick response terrain-related decision aids, such as 3-dimensional views and line-of-sight products. The Condensed Army Mobility Model System (CAMMS) provides warfighting commanders with decision aids regarding tactical ground mobility, such as vehicle speed predictions and route planning products. Both packages operate in a PC DOS environment and are available to Army users. An upgraded composite of Terrabase and CAMMS will be incorporated in the future Digital Topographic Support System, to be fielded in FY 1993-94. POC is MAJ Pat Poulson, AV 676-5715.

Directorate of Engineer Branch Safety (DEBS)

Unreported Accidents. Commanders are requested to report near-miss or minor accidents involving engineer equipment. Such incidents frequently go unreported because there is little or no equipment damage or injury to personnel. However, the Safety

Office needs to be informed about them so that potential major accident producers can be identified. Such reports will also allow us to correct deficiencies in future materiel acquisitions. Examples include instances where equipment is unstable on hills or at corners and problems resulting from poorly designed control panels. POC is Paul Rusinko, (314) 563-5002, or Mark Totzke, 563-7346.

1st Brigade

Senior Warrant Officer Course Vacancies. Openings are available in the Senior Warrant Officer Training (MOS 213A) course at Fort Leonard Wood. The 11-week course is scheduled to begin 28 September 1990 and 18 January 1991. The course includes 2 weeks of common core subjects and 9 weeks of technical, MOS-specific subjects. Students must have completed the Warrant Officer Tactical and Technical Certification Course, be in grade CW3 or CW2(P), and have been accepted for voluntary indefinite status. For more information, call CW4 Harrel Rinehart, (314) 596-8223.

Fast Track Training Program Benefits Quality Soldiers. Selected soldiers in the engineer Advanced Individual Training (AIT) at Fort Leonard Wood can participate in a special studies program called Fast Track. The program is open to all Active, Reserve and National Guard soldiers in MOS 12F, 51B, 51G, 51K, 51R, 62B, 62E, 62F, 62G, 62H, 62J, 81B, and 82B. Students receive additional MOS-specific training, cross training in other selected MOS, and additional common soldier training above the standard Basic Training and AIT programs. To participate, soldiers must have exceeded the Army standards in performance, attitude, military bearing, and physical fitness, in addition to maintaining a 90 percent AIT and Fast Track program academic average.

Upon completion, a letter highlighting the soldier's accomplishments is sent to the battalion commander of their first unit of assignment, and a copy is added to his or her Training Records jacket. I identifies the graduate as a high quality soldier.

The battalion commander also receives a questionnaire to asses the Fast Track graduate's performance at the new unit. Complete questionnaires are a prime assessment tool for the program, and w request they be returned to us. Your information will help increas the benefits of the program to units and the soldiers. POC is SF Gary Shriner, (314) 563-2453.

132d Brigade

Army-wide Sapper Stakes Competition Planned. The Enginee Center will host the first annual Sapper Stakes competition at Fo Leonard Wood on 10-14 September 1990. The purpose of the com petition is to promote standard engineer battle drills and recogniz the best engineer squad in the Army. Ten events are planned f both Active and Reserve Component personnel in divisional, cor combat, light, and combat heavy engineer battalions. A total of 1 seven-man squads representing USAEUR, FORSCOM, WESTCO SOUTHCOM, and USFK/EUSA will participate. POC is CPT Ma Miller, (314) 596-3141.

Bailey's Bridge

By Dr. Larry Roberts

In the early days of World War II, British engineers were faced with the problem of bridging that was inadequate for their new armored and mechanized equipment. Modifications of existing materiel met some bridging requirements, but new equipment was clearly needed.

Mr. Donald Coleman Bailey, chief engineer of the British Experimental Bridging Estabishment, offered a solution to this problem by proposing a bridge design based on panel trusses. Bailey's design met the criteria in erms of manpower requirements, ransportation needs, flexibility of design, and flexibility in load-bearing capacity (see photo on back cover).

Recognizing the advantages ofered by Bailey's bridge, British ngineers rushed the initial abrication, test and, ultimately, production of the panel bridge. The normal design-to-production ime of one year for military hardware was cut almost in half. n seven and one-half months, British engineers had produced he new "Bailey bridge." By the ime the United States entered the war, British engineer units had mployed the Bailey bridge in ombat and had noted its remarkble versatility.

American military engineers aced similar problems—the inreased vehicle weights exceeded he capacities of existing bridging material. Like the British, they intially tried to modify existing ridges to handle the loads. Howver, the success of the Bailey ridge soon prompted the Army to xamine its adoption as a partial answer to the needs of the newly organized armored and mechanized forces. The fact that both armies could use the same bridge offered the possibility of interchangeability of components in tactical situations. If this was possible, it would simplify the production process.

Americans began to work with the Bailey bridge early in 1941, and for the next two years American engineers, civilian and military, tested and modified its design. The major problem with the bridge was the close production tolerances required for the panel sets to be truly interchangeable.

The British approach to production was for contractors to produce the components, with assembly at a central facility. The Americans chose to contract complete bridge sets to American steel and metal fabrication companies. In an attempt to ensure uniformity of production, American engineers acquired master gauges, duplicated those gauges, and provided them to contractors.

Field tests of the Bailey under various conditions confirmed the value of its design and its potential for use in many tactical situations. The Bailey could be used as a semi-permanent fixed bridge, spanning dry gaps or small streams, and it could be used with pneumatic floats or pontoons across wide water bodies.

Early use of the bridge by combat engineers in battle reconfirmed the results of field trials. Throughout the war, Baileys were used in many configurations, from floating bridges to suspension bridges. It could be altered in place, raising its load-bearing limits to accommodate heavier loads and greater volumes of traffic.

The one aspect of the Bailey which defied solution was the problem of manufacturing tolerances. Examination of factory production and reports from field units revealed that American-made sets were not interchangeable with British sets, and sometimes were not compatible with other American sets.

The problem was variation in the gauges used by the fabricators. It was not until the very end of the war that American gauges matched those of British instruments. Interoperability simply did not exist. This forced front-line units to segregate American- and British-produced sets, complicating the logistical support for engineer operations.

The operational value of the Bailey far outweighed the difficulties of production and interchangeability. In Sicily and Italy, the Bailey was often the bridge of choice. In northern Europe, the Bailey complemented the tactical float bridges and assault bridges, especially for armored forces. The Bailey was also used in the Pacific and in China. By the end of the war, tens of thousands of vehicles had crossed versions of the panel bridge that was born of military necessity, constructed by countless British and American engineers, and designed by Donald Bailey.

Dr. Larry Roberts is the historian for the U.S. Army Engineer School and Center, Fort Leonard Wood, Missouri.

PIN: 060535-000

205
v. 20 #3

ENGINEERING

DEPOSITORY
DEC 03 1990
UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

Engineer

PROFESSIONAL BULLETIN FOR ARMY ENGINEERS
lquarters, Deptartment of the Army

October 1990

PB 5-90-3

Personal Viewpoint

Why Study Military Geography?

> ***"If a general desires to be a successful actor in the great drama of war, his first duty is to study carefully the theater of operations so that he may see clearly the relative advantages and disadvantages it presents for himself and his enemies."***
>
> ***Jomini***

Battle is conducted in physical geographic zones traditionally defined by land, sea, air, and more recently, space. As proposed by Jomini, the successful military commander will study and anticipate his theater of operations. The modern commander must understand a complex battle environment, which merges these zones through the synergism of dynamic weapon systems and joint operations.

As the Army's terrain and facility development experts, engineers must develop a battlefield environment perspective. We must also clear the way for a return to the study of military geography as the basis for preparing, altering, and restoring the battlefield for continued cultural development.

The process which provides commanders with the geographical conditions of battle has evolved with the complexity of warfare. The broad study of military geography has various interpretations in maritime and continental strategies, strategic geographic appraisal, and more recently, the Army's tactical Intelligence Preparation of the Battlefield and terrain analysis. Each evolution has adapted to specific needs.

Modern western military strategy has drawn from Mahan (maritime), Mackinder (continental), Spykman (rimland), and Seversky and Douhet (air) in order to describe the character of a particular battle environment. These global views defined geopolitical potential in terms of objectives, position, and technology. They each place a single physical geographic zone (land, sea, or air) in the dominant and decisive battle environment role.

The fixation with one strategic, physical geographic zone represses the potential for environmental synergism among them all. Jomini and Clausewitz offer environmental views at the strategic and operational levels of war. Clausewitz uses terrain, as the key to developing a sense of place, and military geography with its spatial relationships as a primary element when developing the concept of center of gravity. A commander's view of the battle environment will depend on factors like the level of interest (strategic, operational, or tactical), breadth of the area of interest, and the forces at his command.

Let me emphasize that mere data of physical geography (position, topography, resources, population, and climate) have no intrinsic political or military significance. Such data acquire military geographic or political significance only when they are related to some frame of assumption as to what is to be attempted by whom, when, where, and in conjunction with what adversaries, allies, and neutrals. Within the context of military geography, the physical geographical elements of the battle environment (land, sea, air, space) and their associated geoscience disciplines (topography, oceanography, meteorology, astronomy) are not only interdependent, but also relevant to the cultural and operational dimensions.

To be of any value, the data must be communicated in a timely manner and in a form which supports the decision. The synthesis of these elements will provide what the commander needs to know about the battlefield environment.

Without a military geography framework, the commander's decision-making process is deluged with discrete hierarchies of environmental, cultural, and operational data. For example, in combat mobility operations we might merge physical terrain and weather information and not consider the roads and man-made drainage systems that link urban and rural developments.

Or, consider the simple example of mud, which Napoleon called the fifth element of war. Mud is the synergy of soil and water (terrain and weather). The commander, however, is concerned with its effects on friendly and enemy forces, not its composition.

According to U.S. joint policy, geographic area is the most

(Continued on page 26)

By Lieutenant Colonel Robert F. Kirby

Engineer

October 1990

Volume 20 PB 5-90-3

UNITED STATES ARMY
ENGINEER CENTER AND
FORT LEONARD WOOD

COMMANDER/COMMANDANT
Major General Daniel R. Schroeder

MANAGING EDITOR
Catherine Eubanks
FEATURES EDITOR
Phillip R. Howell, Jr.
GRAPHIC DESIGNER
Jennifer C. Bolyard

y Order of the Secretary of the Army:

ARL E. VUONO
eneral, United States Army
hief of Staff

fficial:

HOMAS F. SIKORA
rigadier General, United States Army

ront cover illustration by Alan Speer

FEATURES

4 **Whose Side Are Those !*@#%& Engineers On, Anyway?**
by Lieutenant Colonel Thomas D. MacIver and Major Andrew H. Hough

9 **Staff Rides & The Flawed Works Of Fort Constitution**
by Lieutenant Colonel James M. Johnson

17 **Engineers And The Army Of The 1990s**
by General Carl E. Vuono

22 **STRAC: A Training Strategy That Works**
by Captain Jim Glass

29 **Obstacle Breaching And Marking For Squads**
by Sergeant First Class Bruce Rider

34 **ARTEP Mission Training Plans: Making Life Easier**
by Captain Robert C. Kurtz

38 **Hedgehogs: Iron Animals For Engineers**
by Captain John H. Breidenstine, Jr.

40 **The Command Sergeant Major As Seen By The Battalion Commander**
by Lieutenant Colonel Herbert F. Harback

43 **Revised MQS System Will Enhance Officer Training**
by Captain Jonathan M. Williams and Captain Thomas G. Young

DEPARTMENTS

Inside Front Cover: **Personal Viewpoint**
2 **Clear the Way**
3 **Bridge the Gap**
27 **Engineer Safety**
37 **Engineer Problem**
44 **Engineer Solution**
45 **Lessons Learned**
47 **Engineer Update**
51 **Past in Review**

ENGINEER (ISSN 0046-19890) is prepared quarterly by the U.S. Army Eneer School, ATTN: ATSE-TDM-PB, Fort Leonard Wood, MO 65473-6650. cond Class postage is paid at Fort Leonard Wood, MO, and additional mailing ices.

POSTMASTER; Send address changes to ENGINEER, the Professional Bulin for Army Engineers, ATTN: ATSE-TDM-PB, Fort Leonard Wood, MO 65473-50.

CORRESPONDENCE, letters to the editor, manuscripts, photographs, official it requests to receive copies, and unit address changes should be sent to EN-NEER, at the preceding address. Telephone: (314) 563-7762, AV 676-7762.

DISCLAIMER: ENGINEER presents professional information designed to keep my engineers informed of current and emerging developments within their areas of expertise. Views expressed are those of the author and do not necessarily reflect official Army or TRADOC positions, nor does the content change or supersede information in other official Army publications. ENGINEER reserves the right to edit material.

CONTENT is not copyrighted. Material may be reprinted if credit is given to ENGINEER and the author.

OFFICIAL DISTRIBUTION is targeted to all engineer and engineer-related units.

PERSONAL SUBSCRIPTIONS are available by contacting the Superintendent of Documents, ATTN: Chief, Mail List Branch, Stop SSOM, Washington, DC 20402. Address changes for personal subscriptions should also be sent to the Superintendent of Documents.

CLEAR THE WAY

By Major General Daniel R. Schroeder, Commandant, U.S. Army Engineer School

As we move toward the 21st century, the Corps of Engineers is actively preparing to fight and win anywhere in the world. Future threats will arise swiftly from unexpected and lethal quarters. The key to our success will be a quality force led with doctrinal proficiency by leaders who have prepared for contingency operations throughout the world.

The new Military Qualifications Standards (MQS) system promotes the doctrinal and technical proficiency demanded by the future AirLand Battlefield (see article, page 43). It provides a common ground for our officers, better enabling them to speak the language of the combined arms team. MQS I provides the essential leadership, management, and combat survivability skills needed by officers entering the military service. MQS II, tier 1, taught at the basic course, provides basic engineer warfighting skills necessary for successful platoon leadership in a combined arms environment. MQS II, tier 2, taught at the advanced course prior to company command, focuses on advanced doctrinal, leadership, and management training. Plans are underway to develop MQS III tasks for field grade officers.

To prepare for a complex variety of potential conflicts, the future engineer force structure must be leaner and more battle-focused. Future combat engineer battalions will be organic to maneuver brigades and structured to retain the mobility and momentum of the force in offensive operations. At the division level, the engineer regimental colonel will serve as the maneuver commander's engineer advisor and planner. At the corps level, engineers will provide topographic, countermobility, survivability, and sustainment engineering support.

The combat heavy battalion will evolve into a unit which provides support to installation commanders, while maintaining the capability to support deploying, reinforcing, and contingency forces.

Topographic engineers will produce automated, battlefield geographic information for command, control, intelligence, maneuver, and weapons systems employment. Topographic technology will be integrated with command and control systems to produce sophisticated, understandable tactical decision aids that will enhance the maneuver commander's ability to visualize and exploit the battlefield.

Future engineer organizations will use the latest technology to enhance battlefield performance. Engineers will employ standoff mine detection and clear scatterable mines to improve the survivability and mobility of maneuver units. Sensor technology, such as multi-spectral images, will improve our ability to detect enemy camouflage, while our own ability to hide will improve through developments such as terrain masking.

Reserve Components will continue to play a critical role in "rounding out" the Active Army. They will be fully integrated into the technological and developmental improvements of the Active Army, as they must be to ensure a full range of responses to world contingencies.

In addition to shifts in organizational structure and improvements in technology, more emphasis will be placed on battle-focused training in which the commander's intent is the governing principle of all actions. The lethality of modern weapons systems, their potential for mass destruction, and their widespread proliferation, make it imperative for leaders at all levels to have the skills necessary to recognize and act upon the commander's intent. To survive, units will remain widely dispersed while emitting minimal electronic signatures. They will mass with great speed at the appointed place and time and advance decisively behind a wall of fire, only to disperse again upon achieving their objective.

During each phase of such a future battle, engineers will be a critical asset. They must speak the language of the combined arms team with fluency and be trained to recognize and buttress the commander's intent.

Many of the potential contingencies for which we prepare will stop far short of high-intensity conflict. Rescue and recovery, noncombatant evaluation, and disaster relief, for example, are operations with a critical engineer component. Our organization, training, and doctrine must remain flexible enough to meet these needs.

We are unique among the combined arms team in that the level of support required of us will remain high, regardless of the contingency. We must make every effort to integrate battle-focused leader training with lean, flexible organizations, and improvements in technology. Our success depends on this.

BRIDGE THE GAP

By Command Sergeant Major W. E. Woodall
U.S. Army Engineer School

"They send us in front with a fuse an' a mine
To blow up the gates that are rushed by the Line,
But bent by Her Majesty's Royal Engineer,
With the rank and pay of a Sapper!"

A verse from "SAPPERS," by Rudyard Kipling

The term sapper goes back to the 16th century wars. Since then, sappers have proven their technical and tactical abilities by building and destroying fortifications, roads, obstacles, and airfields.

In the past, success on the battlefield often depended on sappers leading the way. To continue this success, we must develop competent and confident noncommissioned officers who have the ability to operate under stress as team members. Fort Leonard Wood's Sapper Leader Course provides a unique training opportunity for the engineer corps to build these skills.

Mission. The mission of the Sapper Leader Course is to train engineer leaders so they can better support maneuver units. The course trains an engineer company's leadership and focuses on the development of team leaders and squad leaders. Instruction is oriented primarily at the sergeant and staff sergeant skill levels. Many of the topics covered are especially pertinent to light, airborne, and air assault engineer battalions. Although designed mainly for light engineers, the training is available to any combat engineer unit.

Training. The 28-day program provides instruction in a mix of light and special operations engineer skill areas. Topics include air, water, and mountain operations; medical techniques; land navigation; demolitions; expedient antennas and communications; survival; and small unit tactics and patrolling.

While most of the material is taught in a classroom, it is reinforced through repeated practical exercises. Sapper students spend the last 10 days of the course in the field, putting to use the skills and techniques they have learned.

The course teaches our junior leaders how to fight and win as a member of a unit. When an entire unit attends the Sapper Leader Course, the leaders have only one thing to accomplish—to successfully complete the program. In other words, the training is conducted in an environment free from daily distractions. Because it is conducted in a tough, uncompromising environment, units leave the course a better trained and more cohesive group.

Our sapper course challenges every leader regardless of rank, position, or experience. The continuous operations, together with the mental and physical demands, place students in very stressful conditions. Noncommissioned officers are stressed to the limits of their endurance. Obviously, the challenges are many, but equally apparent are the rewards of better trained noncommissioned officers.

The key to success for a unit to graduate as a sapper company is to prepare or train-up the company and its leaders before coming to Fort Leonard Wood.

Preparation. I have watched units attending the Sapper Leader Course, and there are two individual training areas that we, as noncommissioned officers, need to fix: Physical fitness and land navigation skills. These two areas are the major reasons why students fail to graduate from the course. Our training is strenuous, and it requires that soldiers be in peak physical condition. As a minimum, students must be prepared to pass the Army physical fitness test, complete fast-paced runs, and road march as far as 12 miles with a rucksack.

The land navigation course complements the sapper's fitness program. To fully prepare for the sapper leader course, soldiers need to sharpen their basic map-reading and land-navigation skills. These skills are tested over the most rugged terrain Fort Leonard Wood has to offer. The rolling Ozark hills make the land navigation course physically demanding.

To complete the course, students must use different navigation techniques, including terrain association and the use of "attack points." They negotiate the course with rucksacks and as individuals—not as buddy teams. The course is a true test of a sapper's ability to move cross country.

Other skills you may want to sharpen in preparation for the course are math skills, drownproofing, and the combat water survival test.

The Sapper Leader Course is a unique training opportunity for combat engineers. Unlike other schools' programs, the training is primarily for unit leaders and focuses on the development of noncommissioned officers. We invite you and your unit to come and take advantage of this training opportunity. With the proper train-up and warrior spirit, any noncommissioned officer can earn the title of Sapper Leader.

"Whose Side Are Those !*@#%& Engineers On, Anyway?"

By Lieutenant Colonel Thomas D. MacIver
and Major Andrew H. Hough

OK, so the "book," FM 100-5, tells us that divisions "assign" obstacle zones and brigades assign belts.

The purpose of belts is to block, turn, fix or disrupt the attacking enemy. Lanes may be specified through a zone or belt to enable the defender to move—not maneuver—through the area. Obstacles installed by defending engineers have to be located within the belts.

All very nice and neat. Right? The concept integrates the battlefield operating systems of maneuver and countermobility. Smartly done, it integrates fires, too. Trouble is, nobody does it—at least not very well.

The common result is that the defending maneuver force finds out the hard way that "their" engineers put obstacles in surprising places. And such surprises often lead to the uttering of many phrases, the most polite of which is the title of this article.

Everyone thinks they understand the commander's intent and scheme of maneuver when it's first stated. Then everyone takes a copy of the maneuver graphics and goes off in separate directions to put their piece into action. Too often, the maneuver graphics do not show obstacle belts at all, or give only an indication of obstacle-free zones.

Presumably, the engineer recommends belt locations and gets them approved later. But somehow this later approval plan never quite works, i.e., what ends up on the ground never quite jives with the maneuver plan. In the worst cases, obstacle belts are designed "from the bottom up." After well-meaning engineer platoons dot the map with proposed (and then installed) obstacles, the staff engineer "circles" groups of the dots, thereby designating belts for his brigade commander. It may be well coordinated at company/team or even task force levels, but it certainly isn't integrated in the brigade or division scheme of maneuver.

"...we think we have a better, simpler way to keep us engineers well integrated."

In other words, current practice looks good in the brigade TOC, but causes fratricide on the ground.

The lesson is one we, as engineers, have all learned—but seem slow to apply: When the brigade's maneuver and engineer plans are developed separately, the results aren't likely to be integrated. Take this thought across a brigade boundary, and the situation is a magnitude worse. The repositioning of forces, lateral reinforcement, counterattack, and passage all suffer. AirLand Battle remains in the book and doesn't happen on the ground.

Well, here in the hinterlands of the Fulda Gap, we think we have a better, simpler way to keep us engineers well integrated. This article explains the thought behind the process, and why we think it ought to be the next improvement in FM 5-100. The two overlays (Figures 1 and 2) allow you to immediately see what the scheme o maneuver is, and where obstacles will go and why.

In our operations with the 11th Armored Cavalry, the regimenta commander's overlay for a defens (or covering force battle) shows set of engagement areas in whic to focus squadron and/or regimen tal fights. Here, of course, th erms regiment and squadron quate to brigade and task force.

The regiment wants to get the nemy into an engagement box and nen focus all available combat power n him there. If it looks like there is a articularly "target-worthy" enemy rce coming into a box, the regiment ill move friendly elements laterally reinforce the fight. Obstacles help et the enemy into a box and keep im there.

The trick is to install obstacles hat have the desired effect on the nemy without impairing our own gility for lateral reinforcement nd other maneuvers. We ensure uch agility by having the en- ineer in the dialogue when the ngagement areas are first out- ned. The design process usually volves the S-2, S-3, the en- neer, and the fire support coor- nator. We determine where we refer to conduct the fights and here we prefer to maneuver, but hat's not all. We also determine here the obstacle belts should . The obstacle belts may even designed first, and then the est engagement areas stand out.

The necessary obstacle belts and eir purposes are immediately ob- ous when the belts and the ngagement areas are de- gned jointly. In certain places, e need to block enemy move- ent so he can't get around e engagement areas. In other aces, we want to turn the emy and encourage his ovement toward the engage- ent area. In an engagement ea, we want to fix the enemy.

We treat the engagement eas as "fixing" belts because ey are places where we want make the ground "sticky" for e enemy while we apply our mbat power. In some areas, ually well forward, we want disrupt enemy movement, helonment, command and ntrol, and follow-on support. hen the S-2, S-3 and en- neer are bending over the me map together with such thoughts in mind, blocking and turning belts are identified as easily as any other feature of the plan.

When the regimental commander issues his order and overlay, he also assigns obstacle belts; better yet, he articulates their purpose and priority. The way this assignment happens is that the S-3 and engineer draw the belts on the initial operations overlay.

There is no separate overlay for the obstacle graphics. Obstacles are an essential feature of the maneuver plan, so the belts are drawn on the maneuver graphics. Further, the commander specifies the routes he wants to use for lateral reinforcement or other moves. Putting these extra features on the overlay takes no appreciable extra time and it pays big dividends.

Maneuver commanders at task force and team levels are happy because they know what to expect in terms of obstacles in their own and adjacent sectors. They know where they can move and maneuver. Their artillery coordinator is happy because he now has better ideas about where, when and why to target. The engineer battalion and company commanders are happy because they have clear guidance. And the regimental commander is happy because the process is simple—and it works.

What we do is best seen in some examples. Look at the first overlay (Figure 1 on page 6). Suppose the 11th ACR mission is to be a covering force forward of phase line (PL) Mustang. The covering force area is designated by corps as an obstacle zone. The commander's concept is to:

- Delay forward of PL Goodwill.
- Strip away enemy reconnaissance using indirect fires (artillery, air and disruption obstacles).
- Avoid decisive engagement.
- Delay back to PL Goodwill, then defend behind PL Goodwill to make it appear to be the main battle area (MBA).
- Cause enemy deployment.
- Identify his main effort.
- Pass lines rearward and hand off the battle to MBA brigades.

Defending maneuver forces often find out the hard way that "their" engineers have put obstacles in some surprising places. The lack of solid integration of engineer effort can lead, at best, to confusion, and to fratricide in the worst cases.

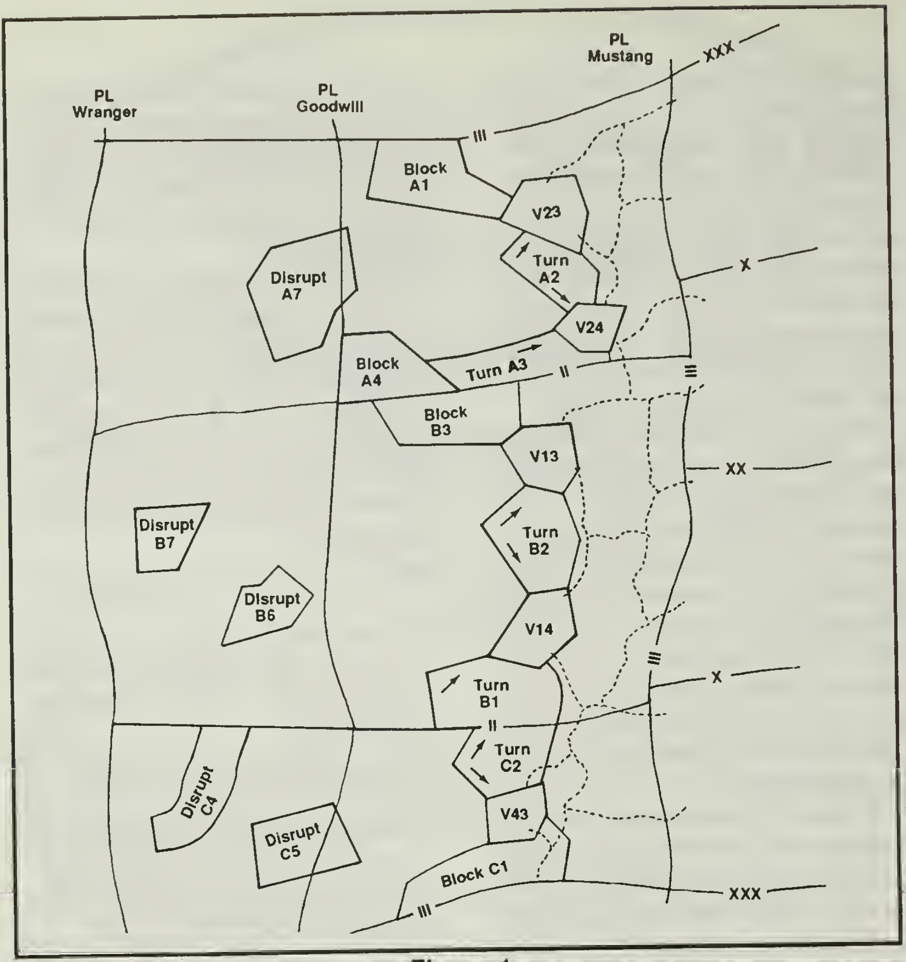


Figure 1

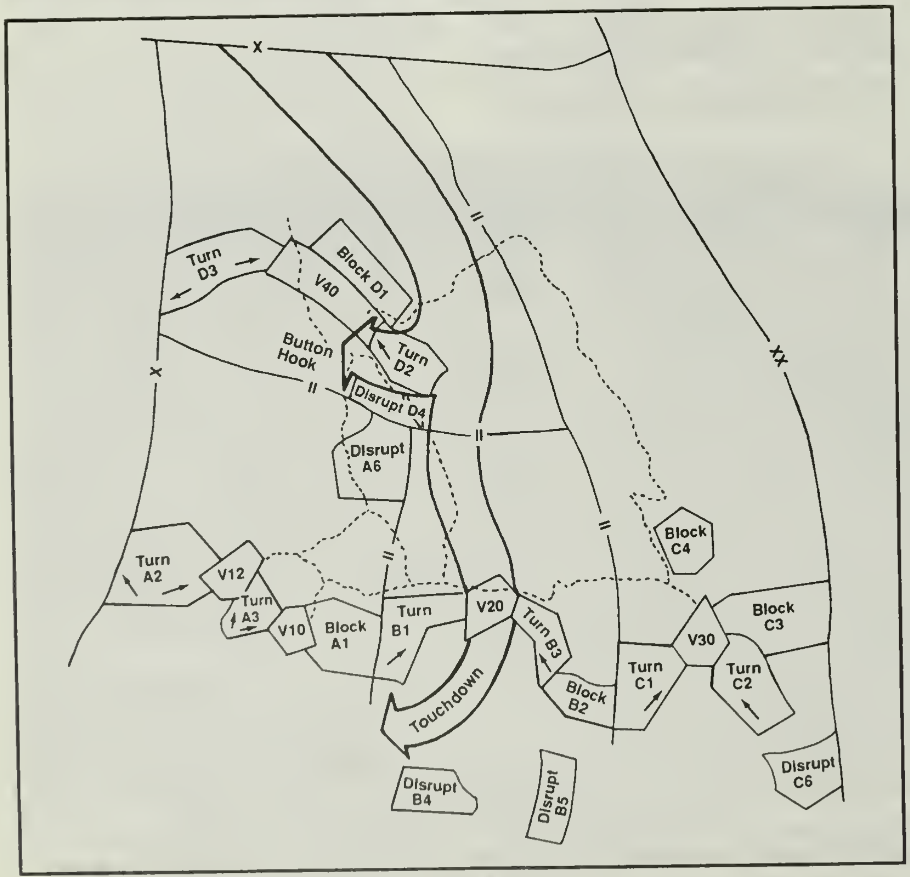
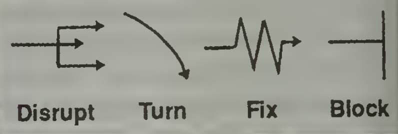


Figure 2

Editor's Note: LTC Roger Somerville, Chief, Tactics, Training and Doctrine Division for the Engineer School's Department of Combined Arms, found the authors' article "on the mark."

The Engineer School is now teaching a technique that solves many typical obstacle integration problems. LTC Somerville writes: "(Our new Engineer School) technique has proven effective on the training center battlefield. It allows for brigade and task force commanders to convey their obstacle intent to subordinates. The synchronization of obstacle effects is, therefore, top driven. However, it also provides the subordinate TF or Co/Tm commander the flexibility to further refine the obstacle intent to fit his particular scheme of maneuver or direct fire plan. Obstacle integration is, therefore, bottom driven where it is most effective."

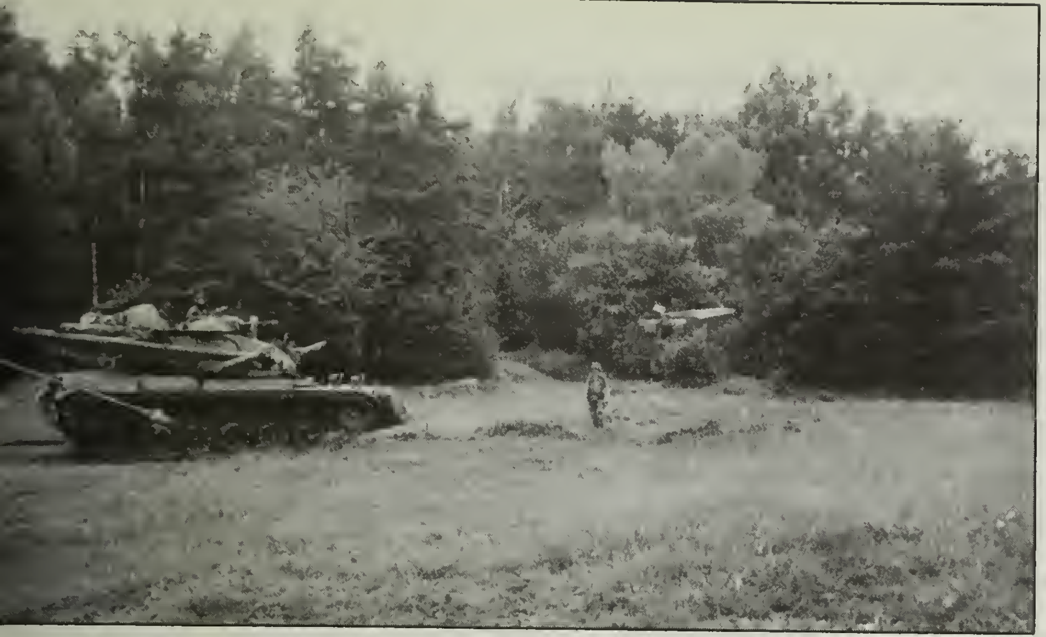
An article detailing this new technique will appear in the next issue of ENGINEER. The authors' graphic overlay symbols, used here to illustrate their technique, should not be used in lieu of the recently-approved symbols which appear below:



The regiment issues the operations overlay, which shows several engagement areas (V—or victory—boxes) in which to focus squadron and/or regimental fights. Each squadron will be positioned across one or two potential enemy regimental avenues of approach. The overlay also shows the obstacle belts, their purpose, and their priority within each squadron (task force) sector.

We depart from the standard symbols shown in FM 5-100 in that we do not show triangular "bumps" on our obstacle belt lines. The bumps make it easy to see the belts on a crowded overlay, but they are a source of confusion. For example, can we place obstacles in a bump or not? Finally, the overlay shows routes we want to be able to use, including what we see as the best exit points for rearward passage. We then recommend these to the MBA brigades for passage points.

The belts are named for their purpose and priority. For example,



Engineer effort on the ground often doesn't match the maneuver plan. In the worst cases, obstacle belts are designed from the bottom up," by well-meaning engineer platoons (U.S. Army photo).

he purpose of belt Block A1 is to lock movement in part of task orce area A. It is also engineer bstacle priority number "1" in this ector. The belt's name carries the egimental commander's intent hat this blocking belt is the most mportant of the belts in this sector.)nce everyone is familiar with the aming system, the belt name may e shortened to simply "BA1."

The turning belts include arows to indicate the direction(s) in /hich we want to encourage nemy movement. Belt "Turn B2" s in task force area B. The belt's urpose is to encourage enemy novement into either engagement rea V13 or V14, and it is the econd obstacle priority in this ask force sector.

The letter designators "A" and B" for different task force sectors re a simple addition to the name f each belt that make the name nique. By the way, there is no pecial reason why we use the leters A, B, and C in this example to efer to different task force areas. 'or better distinction from the "B" nat means "Block," you can use X, ' and Z. In other words, use /hatever provides easy distincion of belts in different areas.

The engagement areas are unerstood to be fixing belts without eing so labeled. The choices of a etter (such as "V" here) and some numbers to name the engagement areas are arbitrary. The numbers do not imply priority. These engagement area fixing belts have a priority lower than that of blocking and turning belts, and this will be covered in greater detail shortly.

Disruption belts, if there is time and effort enough to have any, are also labeled. They have the lowest priority among the belts. It is possible that "ground mounted" engineer effort may not be committed in a disruption belt. Instead, these may be areas where artillery or air-delivered scatterable mines are focused.

Another overlay feature is the series of dashed lines which show regimental routes to be kept open. Where these routes cross into the MBA is where we prefer to conduct the rearward passage. Normally, we give each route a name.

Several features of standard operating procedure (SOP) help keep execution integrated with the commander's intent. Our SOP is that obstacles are planned and installed in accordance with the named priorities. This is not to say that all engineers work first in belts numbered priority 1, then move to number 2, and so on. Available engineers are allocated by platoon to address the needs we estimate in each task force and company/team area. Exactly who works where, on what and when is left to the commanders on the ground.

As work progresses, some task organization changes may occur if our initial estimate needs to be adjusted. In a given sector, work may be in progress concurrently in several different belts. The net result, however, is what one would expect. High priority belts tend to get more effort earlier, have more obstacles in them, and get done sooner than low priority belts.

In general, blocking and turning belts are the highest priority because the fight won't happen where we want it to happen—unless the blocking and turning belts accomplish their purpose first. The fixing belts (i.e., obstacles in the engagement areas) are lower priority than the blocking and turning belts.

Combat power will be focused in the engagement area. It's possible to win the fight there even if there is too little time to install fixing obstacles, as long as the blocks and turns are effective. Disruption obstacles rate the lowest obstacle effort priority. These are not likely to be done by engineers on the ground unless time, materials and engineer effort are plentiful before the fight starts. Artillery-delivered scatterable mines are often very useful in such disruption belts, and they may be the only obstacles planned or installed.

Obstacles cannot be placed outside of belts or on regimental routes unless approved at regiment. Such approvals usually make the obstacle a regimental reserved target, or tie its execution to a specific event (e.g., passage). Squadron (task force) level commanders may designate additional squadron level engagement areas, but these are not new obstacle belts unless so approved at regiment level. Squadrons may also designate additional routes.

In center sector, for example, the squadron commander may fight by positioning one or two of his scout troops (company teams) forward of PL Goodwill. The scouts screen the area between PL Goodwill and PL Wrangler. With help from air scouts, they observe the advancing enemy, send in a steady stream of spot reports, get off a few well-aimed shots, call in artillery and air-delivered fires, and delay without becoming decisively engaged.

The scouts delay back through V13 and/or V14 to pre-determined positions from which to fight the battle focused in the engagement area. Other elements of the squadron are positioned in belts Block B3 and Turn B1. They help the belts serve their purpose by covering obstacles with fire. They also help to "encourage" the enemy into V13 and V14.

The squadron's tank company is in a hide position at the rear of belt Turn B2, and is prepared to move and attack quickly into either V13 or V14. On call from the regimental commander, the tanks may even move out of sector to the north, to V23 or V24, or out of sector to the south to V43, depending on where the best enemy target force is moving.

Engineers continue to install obstacles, improving the belts, until the fight forces them back. As the fight progresses, engineers focus attention on the designated lateral mobility routes and passage routes to ensure they remain open. By the time the enemy gets to engagement areas V13 and V14, his combat recon patrols and forward security elements will have taken a severe beating.

The enemy's advance guard battalion bullies his way into one of our engagement areas. Artillery, attack helicopters, close air support, tank maneuvers, electronic measures and fixing obstacles all come into play as the squadron destroys the advance guard. The action forces the enemy regiment to deploy. The cavalry continues to grind down the enemy as it hands off the battle to the MBA. All across the corps front, enemy regiments are identified and "greeted" in this fashion. We are able to identify the main enemy effort, bloody his nose, make him deploy, and set him up for MBA brigades.

The second example (Figure 2 on page 6) shows a four-task force brigade in the defense of an MBA. One task force is in depth. An important aspect not evident without the map is that there is a significant natural obstacle in the terrain. A difficult ridgeline runs from the northwest side of engagement area V30 to the rear of belts Block D1 and Turn D3.

Forward of the ridgeline, a potential enemy regiment (or larger) avenue of approach runs through V20 to V40. This brigade overlay shows division counterattack axes Touchdown and Button Hook. Such axes are usually designated as obstacle-free zones, but this blanket restriction isn't always required. With some care, it may be reasonable to put fixing obstacles in V20 without impairing Axis Touchdown, and put turning obstacles in Turn D2 without impairing Axis Button Hook.

One criteria for success of the counterattack is that the force must be able to transit the axis without undue impediment, and without fratricide. The counterattack force commander must have approval authority (or, he must have disapproval authority) over what obstacles go into V20 and Turn D2. He and all his leaders, down to M1 and M2 commanders, will need to know precisely what routes will be open, and where each target will be planned. As work progresses, the counterattack force engineer will pay close attention to obstacle reporting by the forward units. V20 and Turn D2 are places where the division engineer earns his pay—helping to ensure that both the defense and the counterattack are supported.

For those division and brigade commanders out there, this is the prescription for the next time you are ready to throw down your kevlar in disgust, and shout "Whose side are those !*@#%& engineers on anyway?"

We're on your side. Just let us help draw smart lines on your operations overlay.

To belt or not to belt. That is the question.

And we have the answer.

Lieutenant Colonel MacIver is the professor of military science at Bucknell University. He previously served as commander of the 54th Engineer Battalion. Other assignments include assistant corps engineer, V Corps; executive officer, 317th Engineer Battalion; assistant professor of physics at West Point, and command of two engineer companies. He is a graduate of Command and General Staff College, and holds a master's degree in engineering applied sciences from the University of California at Davis. He is a West Point graduate.

Major Hough is the S-3 of the 54th Engineer Battalion. He previously served as the regimental engineer for the 11th Armored Cavalry Regiment. He has commanded two engineer companies, and served as resident engineer for the Corps of Engineers in the Netherlands. He is a graduate of Command and General Staff College, and Combined Arms and Services Staff School. He holds a master's degree in mechanical engineering from Washington State University, and is a registered engineer in Virginia.

Staff Rides & The Flawed Works of Fort Constitution

There is an old saying that those who ignore history are doomed to repeat it. It's a truism which holds particular significance for Army leaders. Military successes or failures of a hundred or even a thousand years ago can hold important lessons for modern combat commanders.

But finding a way to take history off the bookshelf and put it to practical use isn't always easy.

One of the best avenues for instilling historical lessons in young military leaders is the staff ride. Staff rides allow commanders to use the accomplishments—or follies—of long-gone military figures to provide important lessons in decision making.

Hundreds of militarily important historical sites throughout the United States provide the backdrop for old problems and crises that can parallel a surprising number of modern military situations. A good example of one of these sites, and one that the Department of History of the U.S. Military Academy uses often, is the juncture of the Hudson River and West Point.

And therein lies the story of Bernard Romans and Fort Constitution—a story that all modern-day engineers should learn well.

The Hudson River and West Point played a significant role in the outcome of the American Revolution.[1] This article will critique the work of Romans, the first military engineer at Constitution Island.

American and British political and military leaders considered the Hudson River militarily significant throughout the American Revolution. George Washington had recognized the value of the Hudson River at least as early as May 1775, when he had served on a committee of the Continental Congress that had recommended fortifying both its sides in the Hudson Highlands.[2] His later view, in 1783 in his "Sentiments on a Peace Establishment," was that the fortifications at West Point had been the "key of America." This had influenced his thinking throughout the war.

Units of the Continental Army generally garrisoned in the Hudson Highlands, and Washington concerned himself personally with the construction of the works along Popolopen Creek and at Constitution Island, Pollepel's Island, and West Point.[3]

The British made the "line of the Hudson" the centerpiece of their strategies to take New York City in 1776, Albany in the Saratoga campaign of 1777, and West Point in 1780 (with the assistance of its commander, Benedict Arnold). The British Commander in Chief, General Sir Henry Clinton, who was involved in all three of these plans and

By Lieutenant Colonel James M. Johnson

West Point cadets view the site of Romans' planned fortifications during a staff ride sponsored by the school's Department of History (U.S. Army photo).

the capture of Stony Point in 1779 later wrote that "the River Hudson naturally presents itself as a very important object."[4]

Washington, Clinton, and their respective political leaders were convinced that the British could bisect the colonial rebellion economically and politically by controlling this major river.[5] The New York Provincial Convention and Committee of Safety repeatedly reminded the Continental Congress of the Hudson's importance "for the defense of the United American States, and keeping up a communication between the eastern and southern states," as it solicited funds for its defense.[6] British subjects and Americans would forfeit their lives and national treasure as they tried to maintain control of this vital artery.

The initial requirements for fortifying the Hudson at West Point had been clear from the very first reports rendered on May 19 by Washington's committee and on June 13, 1775, by James Clinton and Christopher Tappen. Both of these men, sent by the Provincial Congress to determine the best location to block the river, were New York delegates and residents of the Hudson Valley. Additionally, Clinton, a surveyor, had served as a captain of militia in the French and Indian War.

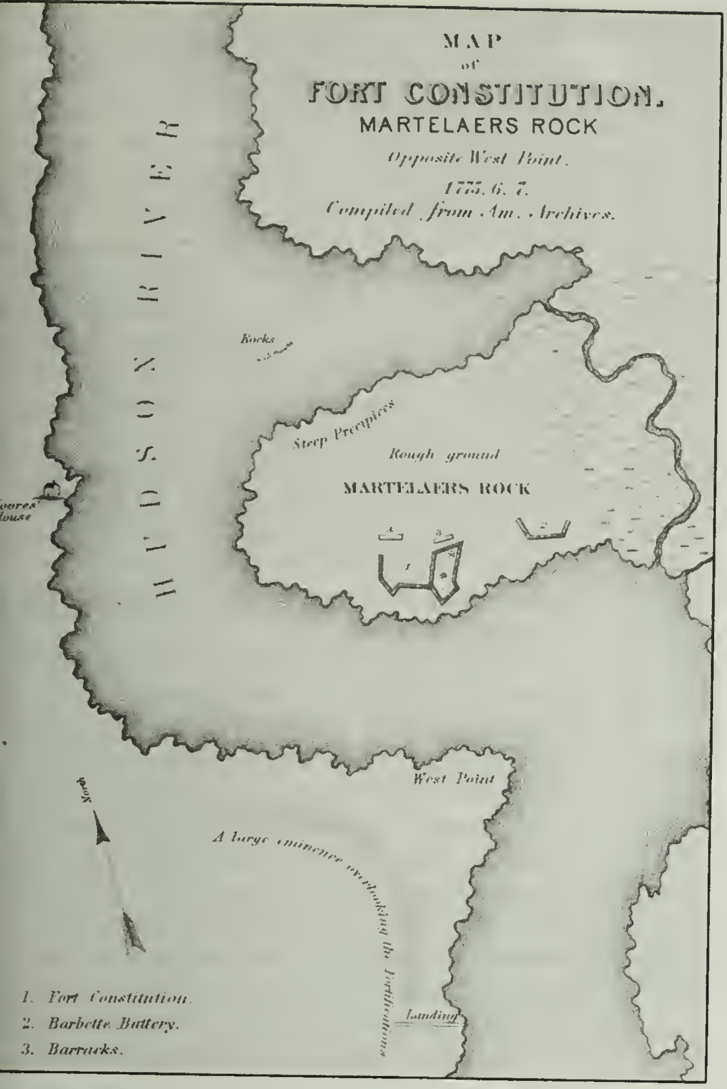
The Continental Congress and the two New Yorkers had agreed that both sides of the river required posts and garrisons. After surveying other sites, such as Popolopen Creek and Con Hook, Clinton and Tappen chose the difficult, "S"-shaped curve at West Point. They believed the narrowness of the channel here and the effects of tide (3-feet high) and current made this the most appropriate spot. Their report included a description and drawing of a post on Martelaer's Rock with a garrison of 300 men and another at West Point with 200 men. They had also recommended stretching booms across the Hudson between the two posts.[7]

Why did a venture that began with such insight and energy result in failure? Why were the works in the Hudson Highlands so flawed that they failed to stop the British in October 1777?

The failure was at two levels. First, the engineer hired by the New York Committee of Safety, Dutch-born surveyor, cartographer, and botanist Bernard Romans, failed as a military engineer at Martelaer's Rock. He did not locate the fortifications there properly. Secondly, he failed to develop them effectively, expeditiously, and economically. On August 29, 1775, Romans began work on a "Grand Bastion," dubbed Constitution Fort.

By February 9, 1776, when the Continental and Provincial Congress dismissed him, Romans had completed only an octagonal, wooden blockhouse with eight four-pounder cannons, barracks, a storehouse, and a curtain or wall mounting a battery of fourteen cannons.[8] Romans' failure at Martelaer's Rock led colonial leaders, who still accepted parts of his general plan for Fort Constitution, to seek alternative sites for fortifications and obstacles. Congressional leaders heard from visiting committees that Fort Constitution was inadequate, and that Popolopen Creek, more than four miles downriver, had off-setting advantages.

Beginning in January 1776, precious manpower and materials were diverted to two forts (Montgomery and Clinton), along with a chain and



boom. A *chevaux-de-frise* (iron-tipped, wooden stakes protruding from sunken log cribs filled with rocks) was to be emplaced between Pollepel's Island, across the river to Plum Point on its west bank.[9]

These works and the *chevaux-de-frise* at Pollopel's Island would divert effort and manpower from Fort Constitution, as it was now called. Consequently, the patriots had incomplete fortifications or barriers at three places and too few soldiers to man them. The end result was failure when success might have been possible.

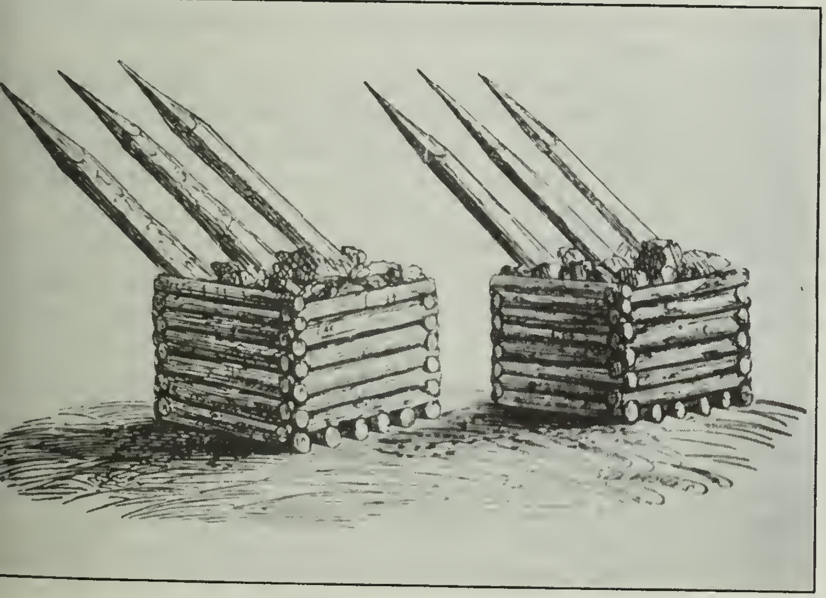
Romans failed at Martelaer's Rock because he did not follow the basic rules of military engineering as they were understood at the time. This is not surprising, because he apparently had little or no practical experience as a military engineer. His biographer cites some training in England prior to 1756, but this presumably was in civil engineering.[10] Romans had a working knowledge of military terms and structures, which he revealed in his observations of Fort St. Augustine, Florida.[11] He had also assessed the cost of repairing Fort Ticonderoga for Benedict Arnold in May 1775, after that once formidable work was captured.

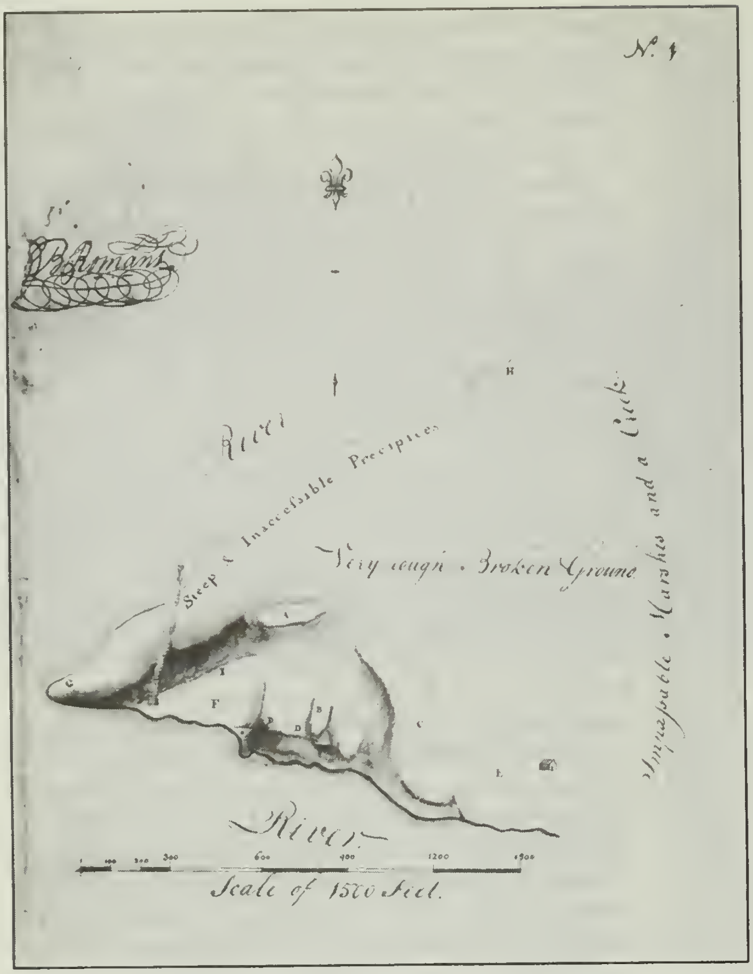
Since his arrival in North America, however, Romans earned his livelihood as a surveyor, cartographer, and botanist. In fact, while he was in the pay of the New York Provincial Congress, the King of England was paying him a 50 pound annual stipend as the botanist for the Floridas.

To his credit, Romans purchased a copy of Roger Stevenson's *Military Instructions for Officers Detached in the Field* in Philadelphia before travelling to New York.[12] He may have learned something about fortifications from John William Gerard de Brahm, a military engineer and his original superior as Surveyor General of the Southern District. However, there is no evidence that he consulted or owned other treatises about military engineering.

Romans would have served himself and his adopted country better had he followed the maxims of acknowledged, published engineers, particularly those of Stevenson. He might then have first built field fortifications of earth and wood that commanded the river rather than starting a bastioned fort of masonry. A committee of the Continental Congress observed on November 23,

hevaux-de-frise




N.º 1
B Romans
River
Steep & Inaccessible Precipices
Very rough & Broken Ground
Impassable Marshes and a Creek
River
1 100 200 300 600 900 1200 1500
Scale of 1500 Feet.

Romans' Plan #1 indicated the terrain seen by Romans on Martelaer's Rock.

1775, that as the southwest curtain was the "least useful, we think it should have been last finished. . . ."[13] Without doubt, Romans was very skillful with a pen, as his drawings and plan of work for Fort Constitution reveal. His approach to his craft as a cartographer and even, perhaps, as a civil engineer are evident in the introduction to his book, *A Concise Natural History of East and West Florida:*

> *A describer of countries, ought in a great measure, to imitate a building Engineer, in first laying before those, whom he will employ, accurate and distinct plans of his intended work, thereby enabling them more distinctly of the execution thereof. . . .*[14]

Unfortunately for Romans, there was and is more to military engineering than a well-drawn plan, a point that John Muller made directly at the time to all who read his treatise on fortifications.[15] The flawed execution of Romans' plan would be his undoing and, ultimately, the Highlands' as well.

Because of his apparent inexperience as a military engineer, Romans chose poor locations for his major works. Had he consulted or remembered the contents of prominent published treatises on fortifications, such as those of Muller, Vauban, or Pleydell, he would have noted their caution to practitioners to be careful about their "choice of situation" and "to make use of every advantage of ground. . ." Muller even thought that leaders should not trust the judgment of a single engineer, even one "so well qualified," but rather should seek other opinions.[16] Unfortunately for the colonies, engineers were in short supply. New York and the Continental Congress had little recourse at the time but to rely upon the careful drawings and detailed estimates of Bernard Romans.

In "his choice of situation," Romans accepted too literally the location on Martelaer's Rock proposed by Tappen and Clinton rather than surveying and tracing out the best site himself. His initial proposal proved that he was not totally bound by the opinion of "Some gentlemen, not well enough versed in the sience [*sic*]. . ." because he had himself found a spot a short distance to the east of the one selected by the committee.[17] Furthermore, after sketching a blockhouse and battery for a site that Clinton and Tappen had chosen at West Point, he had then ignored these dominating heights across the river less than one-half mile away.

Stevenson pointedly warned against allowing such a thing to happen with terrain in the very book that Romans owned and presumably had read.[18]

Although most observers, like Clinton and Tappen, recognized the value of the higher ground at West Point, it would continue to be ignored until 1778. In June 1776, for example, Lord Stirling, General William Alexander, noted that "every work on the island is commanded by the hill on the West Point. . . ."[19] The reason for this crucial oversight may have simply been that Fort Constitution had now become an auxiliary to Forts Montgomery and Clinton. Cannons emplaced at Romans Battery would be unable to take an enemy ship under fire until it was broadside, more than halfway through the "S"-curve.

Field works, made from fascines (bundles of sticks), timber, dirt, and sod—and located farther to the east at the future site of the Gravel Hill

Battery where Romans himself had drawn a blockhouse and a battery—would have at least confronted both problems. Romans would have done well to have remembered or read Pleydell's admonition in 1768 "That an hundred men properly posted, and entrenched according to rule, can effect more than a thousand, who have taken up a wrong position."[20]

Having chosen the wrong place to begin his work, Romans next ignored or misunderstood the command relationship established by the New York Provincial Congress when it appointed the commissioners for the fortifications in the Highlands. As a result, there was no unity of command. The famous French engineer, Vauban, had made clear in his writings that members of his profession were "often forced to follow someone else's opinions and work at strange notions."[21]

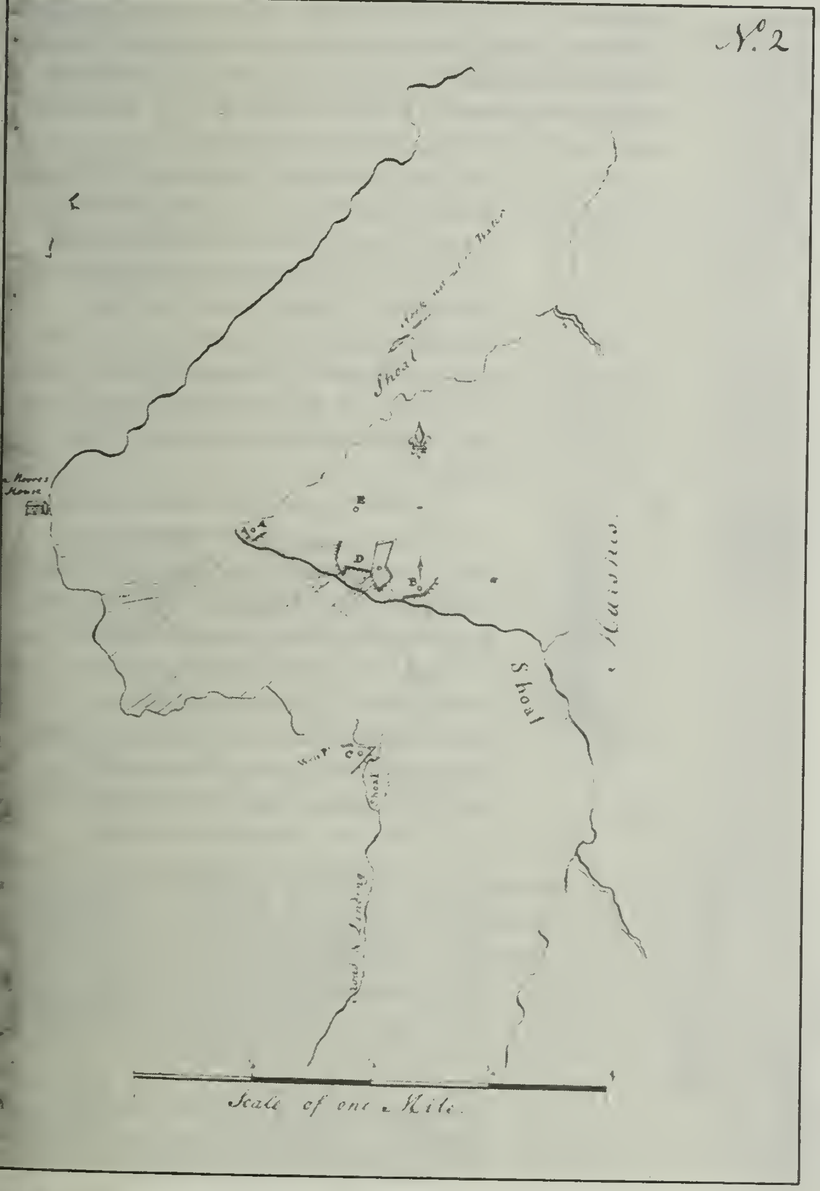
To his ultimate regret, Romans stubbornly or pridefully viewed himself as the sole director of construction. He did not show his original plan to, or coordinate it with the commissioners, who then criticized it without offering an alternative. The plan was delivered directly to the New York Committee of Safety, which forwarded the impressive drawings and estimates to the Continental Congress.[22] This initial action led to increasing animosity and a paper war between the principals of the project—Romans writing from his blockhouse and the commissioners from their office in the storehouse a short walk to the rear.[23] This was not the first time, nor would it be the last, that Romans would show his difficult personality.[24]

Embroiled in controversy first with the commissioners and later with the respective Congresses, Romans proceeded to build a blockhouse and a battery too slowly and at too great expense. Muller had pointed out that a major consideration in planning a fortress must be "The expence necessary in the building of it" to avoid the possibility that "instead of being an advantage, it becomes a burthen to the nation."[25] Tappen and Clinton had originally estimated that the cost of their two proposed posts would be about 1,500 pounds; Romans' initial estimate was 4,645 pounds, 4 shillings, 4 pence, excluding ropes, iron stoves, and artillery. The minutes of the New York governing bodies indicate the routine disbursement of funds to support the construction to the north.[26]

Had the results of Romans' labor been more evident to the many observers sent to evaluate progress, the expense might not have been a major factor. Lord Stirling summarized the issue very succinctly in his report of June 1, 1776: "Mr. Romans has displayed his genius at a very great expence and to very little publick advantage."[27]

Cost became a consideration precisely because, even by the time of Lord Stirling's visit, Romans, the commissioners, and their laborers had accomplished so little of consequence. The commissioners completed a second curtain, to be called Marine Battery, mounting eight cannons.

Investigating committees, influenced by their reports to the Provincial



Romans' Plan #2 shows his original scheme for batteries and blockhouses.

Congress, further added two batteries of fascines, planks, and earth (Gravel Hill—8 cannons, and Hill Cliff—3 cannons) on the eastern end of the island. Here, the cannon could fire on British ships long before they reached Martelaer's Rock.

The British, upon their arrival in October 1777, faced a Fort Constitution that comprised Romans' Battery and Blockhouse, Marine Battery, and Hill Cliff and Gravel Hill Batteries.[28] Even these works, such as they were, would not be tested. The small detachment of militia and Continentals was demoralized by the British victories downriver at Forts Montgomery and Clinton. They would flee these works, third in priority at the time for resources behind the projects at Popolopen Creek and Pollopel Island, after firing only one shot at a British flag of truce.[29]

Forts Montgomery and Clinton fell quickly and tragically for reasons that parallel those that led to the ignominious demise of Fort Constitution. Started in the fall of 1775 as an alternative to Fort Constitution, these works nonetheless competed for men and materials, and later with the *chevaux-de-frise* at the northern gate of the Highlands. Patriot laborers had not completed either of the forts by the time of the British attack.

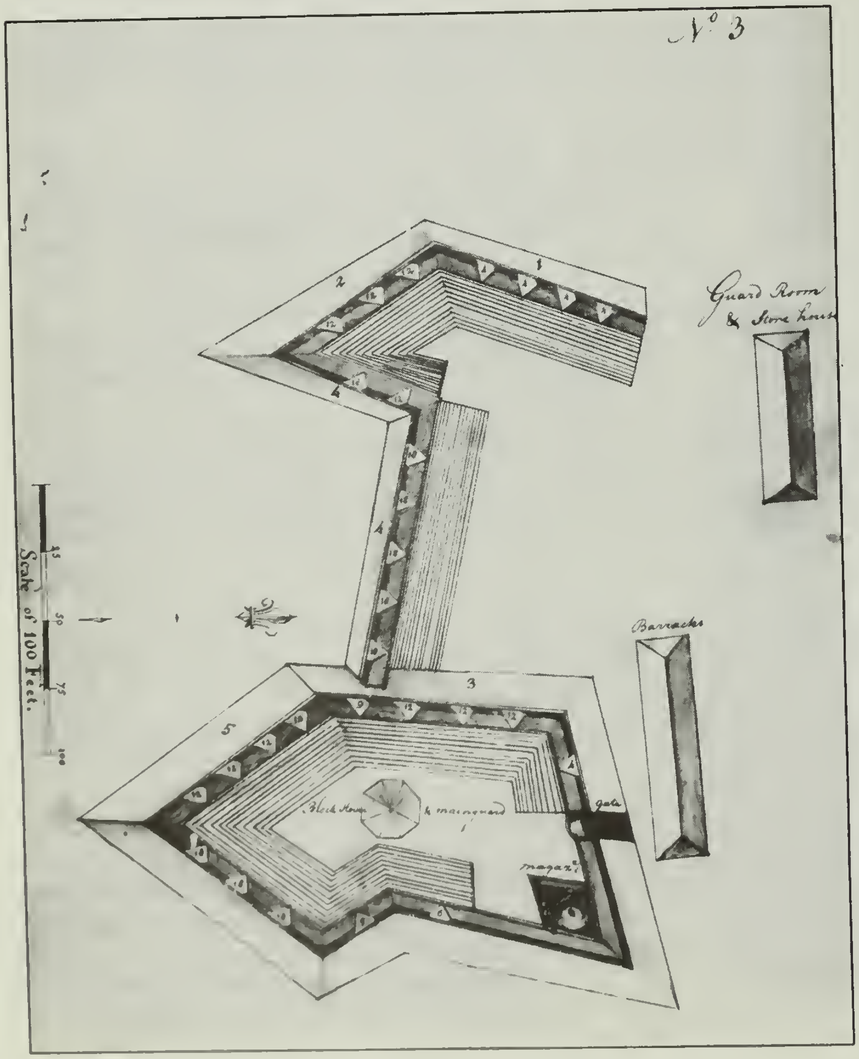
Generals George and James Clinton found that the forts were too large for the few Continentals and militia they were able to muster. Disregarding Washington's warnings, these inexperienced leaders and General Israel Putnam, the overall commander, failed to guard critical passes to the south and west. That allowed the British to attack the landward side of forts, which were tragically and ineffectually oriented on the river.

A chain, boom, row galleys, and Continental frigate served little useful purpose as Loyalist Colonel (and local resident) Beverley Robinson led British Regulars and provincials through Timp Pass and Doodletown. They attacked the rear of the two American works in a final assault that lasted only about 30 minutes. After occupying Constitution Island, the British naval squadron made equally short work of the inadequately defended *chevaux-de-frise* at Pollopel's Island and roamed as far north as Kingston, New York.

The Provincial Convention fled as the British first took and then burned the capital. Unable to save "Gentleman Johnny" Burgoyne at Saratoga, Clinton's soldiers and Hotham's sailors destroyed 2-years' futile efforts by Americans to prevent just such an outrage as they fell back downriver to New York City.[30]

The story loops full circle back to the post proposed for Martelaer's Rock, and the one at West Point—and to Bernard Romans' flawed interpretation of his assignment.

The New York Provincial Congress had hired Romans as a military engineer to block the Hudson River at a point that would begin to prove decisive in early 1778. As his "imagination took wing," Romans squandered time and money trying to build a "Grand Bastion" rather than field fortifications better suited to the needs of the moment.[31] Of even greater significance, he chose to build the fort where it



Romans' Plan #3 of the "Grand Bastion." Romans completed only the center curtain and the octagonal blockhouse.

commanded little and could be dominated from almost every direction.

Romans' initial failure led his political and military masters to fortify Popolopen Creek and Pollopel Island even as they continued some efforts at Fort Constitution. The patriots had too few men, too little time and money, and too little experience to do all of these tasks effectively at the same time.

It is most unfortunate that the reasoning of Silas Deane, of Connecticut, did not prevail in October 1775, as he and fellow delegates to the Continental Congress debated the future of Fort Constitution: "they have employed an engineer. The people and he agree in the spot and the plan. Unless we rescind the whole we should go on; it ought to be done."[32]

The second generation of fortifications at West Point were true to Tappen's and Clinton's original conception. More competent engineers blocked the Hudson with a mighty chain and covered it with the fires of forts, batteries, and redoubts on both sides. Perhaps the words of engineer Pleydell best indicate why success could be achieved at West Point in four short months in 1778, when failure had plagued the work of the previous two years:

> *It is very certain, that many, after throwing away great part of their lives in handling the scale and compass, have yet been unable, on service, to fortify posts as they ought to be; that is to say, they have not known how to take every advantage of the ground, and judge of its strengths and defects.*[33]

Bernard Romans' failure as a military engineer set in motion a chain of events that proved disastrous but not fatal in 1777. Victory would come, and Fortress West Point would play a major role.

Paradoxically, the United States Military Academy later arose at the same site. Its mission was, and still is, to train military leaders to do their job better than Romans did his.

Lieutenant Colonel Johnson is associate professor of history at the U.S. Military Academy. He has served as speechwriter for the Chief of Staff, U.S. Army. Other assignments include S-3 of 2nd Battalion, 78th Field Artillery, and REFORGER action officer for Headquarters, USAREUR. He has commanded two field artillery batteries. He is a graduate of the College of Naval Command and Staff, and holds a doctorate in history from Duke University.

All art, except where indicated, courtesy of Special Collections, U.S. Military Academy Library, West Point, New York.

Notes:

[1] Lincoln Diamant, *Chaining the Hudson: The Fight for the River in the American Revolution* (New York: Carol Publishing Group, 1989).

[2] Worthington Chauncy Ford, ed. *Journals of the Continental Congress, 1774-1789* (Washington: Government Printing Office, 1905) 2:52-53, 57, 59-60; Peter Force, ed., *American Archives*, 4th ser., 6 (Washington: M. St. Clair Clark and Peter Force, 1837-1853) 2: 844-45; George Washington, *The Diaries of George Washington*, ed. Donald Jackson (Charlottesville: University Press of Virginia, 1978) 3:330-31.

[3] George Washington, *The Writings of George Washington from the Original Manuscript Sources 1745-1799*, ed. John C. Fitzpatrick (Washington: United States Government Printing Office, 1938), 26:382.

[4] Sir Henry Clinton, *The American Rebellion*, ed. William B. Willcox (New Haven: Yale University Press, 1954), 11.

[5] Richard Palmer, *The River and the Rock* (New York: Greenwood Publishing Corporation, 1969), chap. 21; Charles E. Miller, Jr. et al., eds., *Highland Fortress: The Fortification of West Point During the American Revolution, 1775-1783*, 2d ed. (West Point: USMA Department of History, 1988), 5-8.

[6] New York. *The Journal of the Committee of Safety*, 25 November 1776, Library of Congress, *Records of the States of the United States*, Reel 1, p. 718, microfilm. (Hereinafter cited by page number from the respective New York governing body).

[7] Report of James Clinton and Christopher Tappen to the New York Provincial Congress, June 13, 1775, Force, 4th ser., 2:1296, map, 736. New York *Journal of the Provincial Congress*, 20, 40-41; Papers of the Continental Congress, 1774-1789 (New York State Papers, 1775-1788), National Archives, Record Group 360, Roll 81, pp. 286, 288-290, microfilm (M247), hereinafter cited as Papers, Continental Congress. Lincoln Diamant's poor copy of the map unfortunately obscures the letter "B" used to mark the "post" at West Point, leading him to conclude in both books that the committee had only meant to fortify Martelaer's Rock. *Chaining the Hudson*, 4, and *Bernard Romans*, 60.

[8] Lincoln Diamant, *Bernard Romans: Forgotten Patriot of the American Revolution* (Harrison, N.Y.: Harbor Hill Books, 1985); New York Provincial Congress, August 18, 1775, Force, 4th ser., 3:535; Romans to New York Committee of Safety, September 14, 1775; Commissioners to New York Provincial Congress, November 11, 1775, Force, 4th ser., 3:733-36, maps between 736-37, 1891-92; also in Papers, Continental Congress, 55-58, 272, 274, 276, 278-79; Romans, "Plan of a Part of Hudson's River Near & About the Fortifications Now Erecting in the Highlands," undated (probably late fall, 1775), USMA Special Collections.

[9] Report of Nicoll, Drake, and Palmer, December 14, 1775, Ibid., 312-19; the Continental Congress had asked the New York Provincial Congress to determine if there were other places "where small batteries might be erected," and Romans had highly recommended "Pooploop's Kill," minutes, October 7, 12 and 17, 1775, Romans, Samuel Bayard and William Bedlow to Nathaniel Woodhull, President of the New York Provincial Congress, October 16, 1775, New York, Journal of the Provincial Congress, 172, 174, 177, 179-80.

[10] Diamant, *Bernard Romans*, 15, 71, 132.

[11] Bernard Romans, *A Concise Natural History of East and West Florida* (New York: Bernard Romans, 1775; repr., New Orleans: Pelican Publishing Company, 1961), 174-75.

[12] P. Lee Phillips, *Notes On the Life and Works of Bernard Romans* (Deland, Fla.: The Florida State Historical Society, 1924), 47, 54; Diamant, *Bernard Romans*, 70.

[13] Roger Stevenson, *Instructions for Officers Detached to the Field: Containing a Scheme for Forming a Corps of a Partisan* (Philadelphia: R. Aitken, 1775); Robert R. Livingston, Robert Treat Paine, and John Langdon to John Hancock, November 23, 1775, Force, 4th ser., 3:1657-58.

[14] Romans, *Natural History*, 1.

[15] John Muller, *A Treatise Containing the Practical Art of Fortification in Four Parts*, 3d ed. (London: W. Strahan et al., 1774), 123-24.

[16] J.C. Pleydell, *An Essay on Field Fortifications* (London: J. Nourse, 1768), vi-vii; John Muller, *A Treatise Containing the Elementary Part of Fortification, Regular and Irregular* (London: J. Nourse, 1746; repr., Ottawa: Museum Restoration Service, 1968); Sebastien LePrestre de Vauban, *A Manual of Seigecraft and Fortification*, trans., George A. Rothrock (Ann Arbor: The University of Michigan Press, 1968), 157; Stevenson, 9; Muller, *Practical Art*, 124, 128-29.

[17] Romans to the New York Committee of Safety, September 14, 1775, Force, 4th ser., 735-36.

[18] Marked "C" on Plan No. 2, September 14, 1775, Papers, Continental Congress, 274. No blockhouse or battery appeared at West Point in his "plan" done in late fall; he seems to have substituted instead a battery at present-day garrison on the eastern side of the river. The sketch accompanying the report of Nicoll, Drake, and Palmer does not indicate any fortification at West Point, December 14, 1775, Papers, Continental Congress, 280-83. "He must take care not to be commanded by any neighboring heights,..." Stevenson, 10.

[19] Lord Stirling to General George Washington, June 1, 1776, Force, 4th ser., 6:672-78.

[20] Pleydell, ix.

[21] Vauban, 168.

[22] Minutes, August 18, 22, 30, September 6, October 16, 18, 23, 1775, New York Provincial Congress and Committee of Safety, Force, 4th ser., 3:535, 541, 567, 571, 880, 1290, 1295-96, 1301, 1363-64; only Samuel Bayard had accompanied Clinton and Tappen on the original survey, ibid., 2:1296; commissioners would continue to supervise construction at Fort Constitution and Popolopen Creek until June 13, 1776 when the Commander in Chief assumed control, New York, *Journal of the Provincial Congress*, 493; minutes, September 25, 1775, ibid., 158-59; New York Committee of Safety to the Continental Congress, September 19, 1775, Papers, Continental Congress, 41; John Berrien to the New York Committee of Safety, September 21, 1775, Phillips, 112.

[23] The correspondence exchange between the commissioners and Romans may be found in Force, 4th ser., 1355-67 and in Merle G. Sheffield, *The Fort That Never Was: A Discussion of the Revolutionary War Fortifications Built on Constitution Island, 1775-1783* (West Point: Constitution Island Association, 1969), 13, C-1-C-12.

[24] Captain Mott of the Connecticut militia had commented on this in his journal while enroute to Fort Ticonderoga in May 1775: "Mr. Romans left us and joined us no more; we were all glad, as he had been a trouble to us, all the time he was with us." General Philip Schuyler would later prefer court-martial charges against Romans, now the commander of a Pennsylvanian company of matrosses, in April 1776, during his march to the Canadian Department, Diamant, *Bernard Romans,* 52, 123-26.

[25] Muller, *Practical Art,* 130.

[26] Report of Clinton and Tappen, June 13, 1775, Force, 4th ser., 2:1296; Romans' estimate, September 18, 1775, Papers, Continental Congress, 55-58.

[27] Lord Stirling to General Washington, June 1, 1776, Force, 4th ser., 6:672-78.

[28] Ibid., 6:678.

[29] Sir Henry Clinton to Sir William Howe, October 9, 1777, and Commodore William Hotham to Lord Viscount Howe, October 9, 1777, Donald F. Clark, ed., *Fort Montgomery and Fort Clinton* (Fort Montgomery, NY: Town of Highlands, 1952), 12, 14.

[30] For the most complete story of the state of the forts and their fall, see ibid., 3-16; William H. Carr and Richard J. Koke, *Twin Forts of the Popolopen: Forts Clinton and Montgomery*, New York 1775-1777, Historical Bulletin Number 1 (Bear Mountain, NY: Commissioners of the Palisades Interstate Park and the American Scenic and Historic Preservation Society, July 1937); report of Court of Inquiry to His Excellency George Washington, April 5, 1778, and Alexander McDougall to Washington, May 21, 1778, Alexander McDougall Papers, New York Historical Society, microfilm.

[31] Diamant, *Bernard Romans,* 72. Report of Francis Nicoll, Joseph Drake, and Thomas Palmer to the New York Provincial Congress, December 14, 1775, Papers, Continental Congress, 312-19; report, 4:420-22, Lord Stirling to General Washington, June 1, 1776, 6:672-78, Force, 4th ser.; New York, *Journal of the Provincial Congress*, 322, 330; minutes, February 1776, Ford, 4:133-34. (In a 2-day visit to the Highlands, Captain William Smith, the engineer of General Charles Lee, traced out the former on Gravel Hill on a site identified but not fortified by Romans because the Continental and Provincial Congresses had dismissed him as of February 9, 1776. Smith would also propose a trace for Fort Montgomery).

[32] Notes of debate, October 6, 1775, Ford, 3:485.

[33] Pleydell, xii-xiii.

HERE STOOD
"THE FORT THAT NEVER WAS"

Art courtesy Constitution Island Association

Engineers and the Army of the 1990s

By General Carl E. Vuono
Army Chief of Staff

Throughout our long and proud national history, the U.S. Army Corps of Engineers has played a unique and vital role—in both peace and war—in building and protecting this nation. From the construction of the nation's capital to the opening of the west, the Corps of Engineers has helped forge the very foundation upon which this nation rests. Throughout the land, countless bridges, waterways, monuments, and railroads serve as silent reminders of the timeless contributions of the Corps to the American people.

U.S. Army combat engineers take a back seat to no one in valor and courage in battle. Engineers like Private Junior N. Van Noy, a 19-year old from Idaho and a posthumous winner of the Medal of Honor in New Guinea, have helped defend this nation with their sweat and with their blood for more than two centuries.

As proud heirs to this legacy, the engineers of today—along with the Army they serve—are poised on the brink of new challenges and new opportunities. In this article, I will discuss the Army's view of the future and my perspectives on how the Corps of Engineers must evolve to meet our national objectives in this decade and beyond. Finally, I will discuss the single most important quality that each engineer leader must have as we approach an era of great change. That quality is professionalism.

The International Environment

No discussion of the Army's future can begin without an examination of the evolving international environment—for that environment dictates the characteristics and qualities that the Army must have to fulfill its strategic obligations to the nation. It is no secret that the current international environment is in the throes of dramatic change, particularly in Europe and the Soviet Union. Over the course of the past year, we have witnessed events of profound significance, and we have seen the once monolithic Soviet empire begin to unravel.

These are events that, first of all, demonstrate that our unrelenting defense of freedom has not been in vain. Put simply, democracy in Europe is winning, and the emerging triumph is due, in no small measure, to the selfless service of millions of American soldiers. These are the soldiers who have manned the ramparts of freedom along the Iron Curtain for four decades and who, supported by the other services and standing shoulder to shoulder with our NATO allies, have broken the back of Soviet aspirations in Europe.

But the struggle is not yet over, and the victory is not yet won. In Europe we have yet to build a new and enduring security structure from the ashes of the old order, and there remain many challenges that the free world must confront before we can pronounce that continent safe for democracy. Indeed, as we listen to the clamoring of many to cash in on the so-called "peace dividend," we must also remember the haunting words of Neville Chamberlain who, in 1938, pronounced that the world had achieved "peace in our time." As history records, less than a year later that same world was embroiled in the mightiest war in human experience—a global conflict that would consume whole nations and leave 50 million dead.

I am not suggesting that the Europe of 1990 is teetering on the brink of a world war. But the continent is clearly entering a period of great uncertainty and potential instability as newly emerging democracies and, indeed, the Soviet Union itself, struggle with the impact of cataclysmic change. This argues strongly that the United States, in conjunction with our NATO allies, must remain a bulwark of stability and an anchor of continuity as the winds of uncertainty howl through the continent.

At the same time, we cannot ignore the emerging military power of nations in the developing world where regimes hostile to the United States are acquiring vast arsenals of tanks, artillery, ballistic missiles, and chemical weapons. These capabilities join forces with regional animosities, ethnic conflicts, religious hatreds, and the lust for economic power to create a world simmering with the potential for violence and war.

For those who would argue that warfare and conflict are relics of the past and that economic power now commands the international community, I would only point to the ongoing levels of violence that we see around the world—violence at a level that was demonstrated by the Iran-Iraq war and demands an effective ability by the United States to respond.

In the international environment of today and tomorrow, it is a cold, hard reality that military force remains a primary instrument of national power. If we are to create a better, more peaceful world in the next century, we must recognize that such a world can emerge only if armed conflict becomes such a fruitless alternative that the community of nations has little choice but to resolve international disputes in a nonviolent fashion. This, in turn, demands a powerful United States Army to deter aggression and to defend America's interests wherever they are threatened. This is an inescapable requirement for this nation and the price of admission for a superpower in the decade of the 90s and beyond.

The Corps of Engineers has a central part to play in the Army of the 1990s, for the Corps uniquely serves the nation across the entire spectrum of operations—from peacetime competition and nation assistance to international conflict and global war.

Shaping the Force

As we shape the Army and the Corps in a complex and demanding environment, we must keep our eyes firmly fixed on a simple vision of the future—a vision of a trained and ready Army today and tomorrow capable of meeting its strategic obligations anytime, anywhere.

In fulfilling this vision, we begin from an enviable baseline. Put simply, the Army of today is the finest peacetime force this nation has ever fielded. It is an Army that is built on the solid foundation of six enduring imperatives—principles that serve as an anchor of continuity in an era of change and as a beacon to steer us into the next century. I have written and spoken extensively about these imperatives, but they bear highlighting because of their central importance to the Army and to the Corps of Engineers.

First, the Army must maintain an effective and evolving warfighting doctrine—effective for today and evolving for tomorrow. In the midst of extensive discussions of maneuver and fire support, it is no exaggeration to say that the success of our doctrine of AirLand Battle—and its tenets of agility, initiative, synchronization, and depth—depend upon our engineers. This is because engineers provide our maneuver elements with the capability to move quickly, to mass effectively, and to achieve overwhelming combat power at the critical point. Moreover, engineers are crucial in shaping the battlefield to deny the enemy freedom of movement, in enhancing the survivability of our forces, and in expanding the lethality of our battlefield systems.

As our doctrine evolves into AirLand Battle-Future, the role of the engineers will become even more important to the combined arms team. Engineers at all levels must understand the Army's doctrine and, equally important, be proficient in the tactics, techniques, and procedures that bring doctrine to life on the battlefield.

Second, we must maintain a mix of forces—armored, light, and special operations—in our Active and Reserve Components. This force mix gives us the indispensable capability to tailor force packages that are appropriate to the threats we face. As an integral element of each of these forces, engineers must understand their unique capabilities and must be able to function effectively in force packages of diverse designs. Engineers from heavy units must be prepared to work alongside units from light elements, and all engineers must be capable of supporting the unique requirements of our special operations forces.

Next, we must continue to modernize the force, even in the face of severe budgetary constraints. We modernize for a single purpose—to enhance our combat capabilities. Our modernization strategy is straightforward and effective. First, we will continue to modernize those systems in which we have a significant battlefield deficiency. The forthcoming fielding of the M9 Combat Earthmover, the VOLCANO multiple mine delivery system, and the Digital Topographic Support System will address pressing needs we have in each of these areas. Second, we will accept some near-term risk by deferring, delaying, or deleting other systems. Certainly, no leader likes to accept additional risk. But, if we must accept risk to meet the constraints of the budget, now is the time to do it.

The more distant future, however, is far less certain. Accordingly, the last element in our modernization strategy is to continue to invest heavily in research and development, pushing back the frontiers of technology

Army engineers drill a well as part of our nation assistance program. Engineer efforts in this program will become increasingly important in the 1990s as we defend America's interests abroad (U.S. Army Photo).

and seeking genuine "leap ahead" improvements in weapons systems beyond the year 2000.

Engineers have a uniquely important role in the modernization process. Not only must engineers absorb and adopt new equipment themselves, they must also provide the facilities, the training simulators, and the support that make every other modernization plan work.

The fourth imperative is our uncompromising commitment to tough, realistic training. Each of us must understand one of the iron lessons of history—the more we sweat in peace, the less we will bleed in war. So every time you spend that extra hour planning training, every time you invest that extra effort in executing training, and every time you devote that extra energy to assessing training, you are investing in the security of this nation and protecting the lives of America's soldiers. As an Army, we must never back away from setting and enforcing the highest standards in training that we can possibly achieve.

The Corps of Engineers faces unique training challenges, for you must work diligently to ensure that the engineers are fully integrated in training the combined arms team. Maneuver and fire support commanders must understand what the engineers can do and how to exploit your almost limitless potential to influence the outcome of battle. Every engineer must become a tireless proponent of mobility, countermobility, and survivability, always with your eye firmly fixed on the scheme of maneuver you are supporting.

Engineers within our districts have equally daunting challenges in the training arena. You must maintain and build your technical skills while you are working on the tasks and projects that support our national infrastructure.

Regardless of your training responsibilities, however, the principles of sound training remain the same. FM 25-100 outlines the Army's fundamental concepts for training. This year we have completed FM 25-101, which provides "how to" instructions for the execution of the principles contained in FM 25-100. Together, these two manuals form a solid foundation upon which an effective training program can rest.

As the Army's fifth imperative, we continue to develop competent, confident leaders with unmatched ability—officers and NCOs who are fully capable of leading the Army to victory anywhere in the world. In the Corps of Engineers you have special responsibilities, for each of your leaders must be an integrator of combat power and must fully understand how to lead in the combined arms team. And equally challenging, our engineers must be particularly adept at dealing with civilians and community leaders around the world. You must understand their concerns and their desires as you fulfill your responsibilities in engineer districts throughout the United States and in nation-assistance operations in the far reaches of the globe.

For engineers of all ranks, your model must be engineers like General Bill Hoge, after whom the headquarters building at Fort Leonard Wood is named. General Hoge cut his teeth as a professional engineer on the spines of the Canadian Rockies, building the AlCan Highway, which remains a marvel of engineering today. He led engineers in combat in two world wars and ultimately rose to command the IX Corps in Korea. He was a leader who understood not only the technical aspects of his trade but also the integration of combat power that is fundamental to victory. His is a proud legacy to which every engineer should aspire.

Tomorrow's Army will depend on highly trained engineers who are capable soldiers and experts in the art of war. Competence and the willingness to accept responsibility are hallmarks of the professionalism demanded of soldiers now and in the future (U.S, Army photo).

The final imperative—last listed but first in importance—is to maintain a quality force. Throughout the ages it has been the quality of the soldier that has made the difference in battle and has determined the fate of nations. Quality is the very foundation of the entire Army and, indeed, of our national defense.

And quality is particularly vital to the Corps of Engineers for, whether in the crucible of combat or in the building of nations, your work is of singular importance. By the very nature of your tasks, engineers are often required to work individually or in small groups with little supervision. This, of course, requires the highest quality soldier our nation can produce. We achieve that quality in the Army and in the Corps by establishing an environment that attracts young Americans into our ranks and encourages our veterans to remain. This must be an environment that fulfills each soldier's highest expectations for personal growth and professional achievement.

These are the Army's six imperatives and the principles by which we must shape the Corps of Engineers for the future. Building on these imperatives, we have created an Army of unchallenged capability today. By sustaining these imperatives, we will maintain the Army that our nation needs in the challenging times ahead.

Vision of the Army

As good as the Army is today, and as competent as the Corps of Engineers has shown itself today, we cannot stand still. In an era of historic change and unprecedented challenge, we must move forward aggressively to shape the Army to meet our national responsibilities and to respond to increasingly austere budgets. We must apply the lessons of the past and take command of our own destiny. For if we do not, someone else will.

In forging the Army of tomorrow, we are guided by a single, clear commitment. We will not compromise, equivocate, or yield on the six imperatives. Even under the most Draconian budgetary constraints, we must never accept an Army that is undermanned, ill-equipped, or poorly trained—an Army that we allow to be fractured by the budget or one that will be neither credible for deterrence nor capable of defense.

Our choices are clear. We can either maintain an artificial force structure at the expense of training and readiness, or we can build a smaller force in which our standards of training and readiness are not sacrificed. Although it is painful to take down the flags of proud divisions, that is the road we must take if we are to maintain the trained and ready Army that our nation will require in the tumultuous decade ahead.

Accordingly, over the course of the next five years, we will carefully, deliberately, and gradually shape a smaller force, including a smaller Corps of Engineers. We will shape the force based on the Army's overall plan that we have developed and refined over the course of the past two years—a plan that has our strategic responsibilities as its foundation and takes into full account both the evolving international environment and the budget realities we confront.

If we adhere to this plan, we will continue to have an Army that has the vital characteristics needed to support our nation's security. It will be an Army that is versatile in its ability to respond to crises, conflicts, and contingencies worldwide—from Central America to Europe; from the Persian Gulf to Northeast Asia. We will be an Army that is deployable—able to project significant land forces quickly to trouble spots around the world. And we will be an Army that is lethal—lethal to fight and win on any battlefield, against any enemy, anywhere our interests are threatened.

The Corps of Engineers is central to each of these characteristics, for you provide the Army the indispensable ability to move throughout the length and breadth of the battlefield, to survive in an era of unprecedented destructiveness, and to dictate the shape of combat to an enemy.

Professionalism

The Corps of Engineers has a bright future as an integral component of the trained and ready Army and as a national asset of enormous value. For those of you who are facing uncertainty as we shape the Army for the future, I say to you: Do not fear the night. The Corps of the 90s will be a challenging, exciting, rewarding place to be, and the engineers will always have room for quality men and women, in both the Active and Reserve Components.

As you prepare yourselves to meet the challenges of this Army in a brave, new world, there is an overriding characteristic that each engineer must adopt as a personal creed. That characteristic is professionalism—only a single word but a powerful concept that embraces all that you can be, all that you must be, and all that you shall be. I have written about professionalism in other fora, but I want to reiterate the components of this vital characteristic because they are of singular importance to the future of the Army and to the lives of each engineer.

First, Army engineers must be competent in the profession of arms, expert in the art of war, and the most capable engineers this nation can produce. Competence is not an inherited trait; it grows from study, discipline, and plain hard work. Throughout your careers, you must continuously acquire expertise from our educational institutions, both military and civilian, from your operational assignments, and from your own independent efforts.

This must be an ongoing process, for the world does not stand still. Onrushing technology, changes in doctrine, and the evolution of the challenges we confront demand that competence be built and sustained throughout an entire lifetime. And your competence must extend far beyond the confines of engineer tasks. In order to properly apply your expertise, you must be knowledgeable in every element of the combined arms team—you must understand the principles of maneuver, fire support, command and control, and every other battlefield operating system that is influenced by the work of the engineers.

But competence alone is not enough. To be a professional, you must willingly embrace responsibility—responsibility for the performance of your unit and responsibility for every soldier with whom you serve. Engineers share a special responsibility to the rest of the combined arms team; you deal in tactics, techniques, and procedures that may not be fully understood by the units you support. You must persevere in the sure knowledge that your efforts may well determine the difference between victory and defeat and will certainly decide the fate of great numbers of soldiers.

Finally, a professional must be committed to the profession of arms and to the nation. You must be willing to serve in the difficult assignments and in the isolated posts, and you must be prepared to give your life for the defense of the nation. It is this commitment that lends meaning to sacrifice, and it is this commitment that lends honor and humility to personal achievement.

These qualities of competence, responsibility, and commitment make up the professional of today—a leader of rare distinction and an asset to be carefully nurtured throughout an entire lifetime.

Conclusion

Perhaps at no time in our national memory does the Army offer such challenge and such opportunity. Our profession asks much of us, but that is not surprising, for ours is a special calling. We are entrusted with an awesome responsibility—the protection of a great nation and the defense of freedom worldwide.

Engineers throughout the world should take enormous pride in the important contributions you are making to the preservation of the ideals upon which this nation was founded. To people all over the world—to those who have freedom and those who aspire to it—the American soldier is the embodiment in the ideals and principles of individual liberty for which the United States stands. And often the American soldier is represented by the young Army engineer helping to build a road, a school, or a bridge, and symbolizing for many the hope of a better life.

You and I have a sacred obligation to our fellow soldiers, to the U.S., and to freedom everywhere. We can never relax our efforts to maintain a trained and ready Army and a Corps of Engineers second to none. I ask that every engineer in the Army now rededicate yourself to the spirit embodied in your motto as we confront the challenges of tomorrow: *Essayons—Let Us Try*. No nation could ask for more.

STRAC:

By Captain Jim Glass

Training with mines and demolitions is dangerous. It is also a necessary part of preparing engineers for combat. And the job of teaching soldiers these skills is tough enough without having to wrestle with the system to get the munitions you need for training.

For the foreseeable future, the expected reduction in training funds will require leaders to make ingenious use of increasingly limited resources to produce combat ready engineers. The Standards in Training Commission (STRAC) provides some answers to these challenges.

As a company commander in the 9th Infantry Division, I knew that the S-3 and S-4 used STRAC to determine how much ammunition and munitions (Class V) I would receive in a given year. I even reviewed STRAC in the vain hope that I could increase the amount of ammunition my company would get.

No such luck.

The assistant S-3 who managed the 15th Engineer Battalion's ammunition account could only get the ammunition that was available at division. If there was a

Training Strategy that Works

shortage of mines, for instance, then those precious munitions were divided equally among the companies.

The only bright spot in this picture was the hope of a training bonus at the end of the year. If a fellow engineer or other combat arms unit had been too busy to use up its allocation—or had done a lousy job of planning its training schedule—I could often get my hands on the leftover Class V. What also helped sometimes was being able to get munitions through the maneuver units we were attached to during training. Often, they were able to provide most of the Class V we needed.

One thing that STRAC does well for the average commander is to outline training strategies vital to the process of becoming an engineer. After becoming familiar with STRAC, I knew how many times a year to train mines, demolitions, and other weapons to be considered a qualified, competent engineer unit. I also knew the recommended ammunition requirement. Not only did I know this for engineers and engineer systems, but I also knew what my fellow combat arms units needed.

Common Standards

The STRAC program is managed at the Army Training Support Center (ATSC) at Fort Eustis. The program provides commanders and other unit trainers with a common set of standards for weapons and weapon systems qualifications. Suggested weapons training strategies outline the minimum attainment and sustainment standards needed to be a proficient engineer. These standards are measurable and will assist the commander in evaluating a portion of his unit's overall training readiness.

The Engineer School (USAES) analyzes proponent training strategies and munitions allocations for mines, demolitions, and the combat engineer vehicle (CEV). The Infantry School recommends the strategies to qualify with all small arms, anti-tank weapons, and claymore mines. The other proponent branch systems and weapons (e.g. howitzer, tank, etc.) do not directly apply to engineer units.

The revised DA Pamphlet 350-38, *Standards in Weapons Training (STRAC)*, is scheduled for publication in October 1990. It

---

One thing that STRAC does well for the average commander is to outline training strategies vital to the process of becoming an engineer.

---

has some new training strategies and ammunition allocation recommendations that will change how engineers train.

It does not, however, completely resolve some issues that are still being debated in the engineer community and the Army.

The Engineer School conducts a biannual Council of Colonels to review changes submitted in the engineer arena. These recommended changes come from the engineer community and other branches of the Army that train with mines and demolitions.

The Engineer School's Directorate of Training and Doctrine (DOTD) coordinates requests for changes, and facilitates the analysis to support justified requests. All requests, by the way, are considered justified unless sound reasons are found that cause them to be rejected. The approved recommendations are then submitted to ATSC for approval and funding.

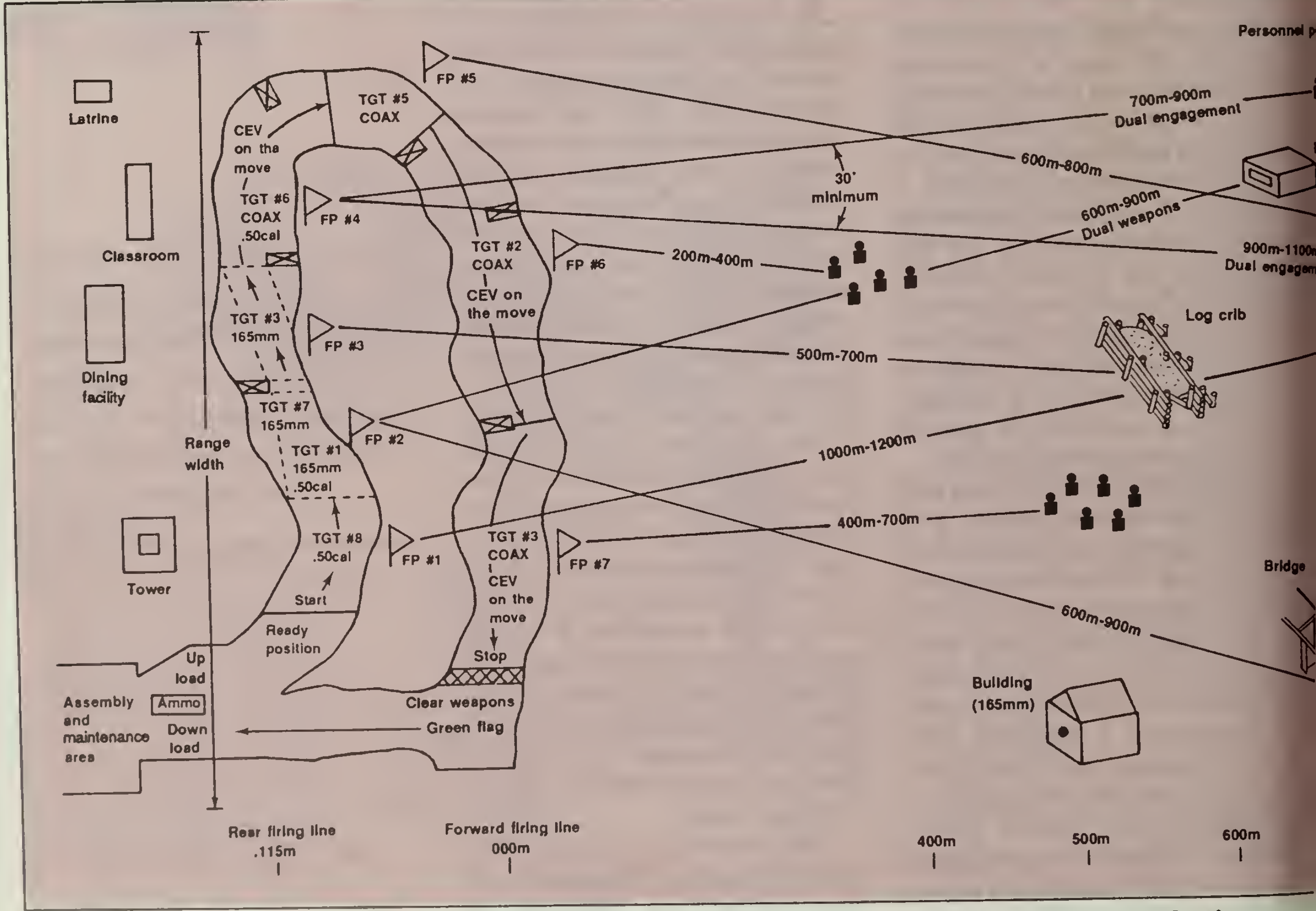
The 1990 STRAC revision changes the training readiness conditions (TRC). These TRCs contain recommendations on how much Class V you get, and how many times you must train to be considered qualified.

The Department of the Army assigns TRCs on an annual basis. Factors considered in assigning TRCs are deployment times, contingency missions, prepositioning of materiel configured to unit sets (POMCUS) fill, and home station locations. In general, TRC "A" units are those in the Active Army. TRC "L," which replaces the old TRC "B" category, will represent those units in the light infantry divisions. TRC "C" covers the reserve units.

An Issue At Point

During the on-going STRAC process, one of the issues coming under close scrutiny by the Engineer School and by the Army is live mine training. While DA has temporarily banned the use of live mines for training, the Engineer School advocates that engineer units must be allowed to use antitank mines in training. Such training should be conducted, according to the engineer community, based on a unit's mission essential task list (METL), a risk analysis by the chain of command, and the amount of Class V available.

The use of live mines to train the individual skills that support such tasks as installing a point minefield or conducting a hasty minefield breach will insure that engineer soldiers and leaders are

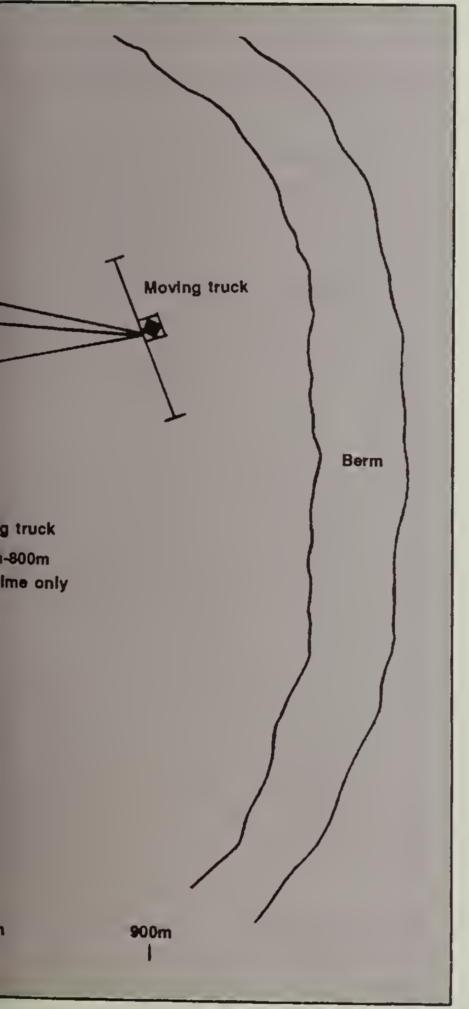


The new STRAC-approved CEV Table V is scheduled to be incorporated into the next revision of TC 5-117, "*Combat Engineer Vehicle Operations.*" The expanded table will permit multiple engagements and firing on the move.

able to gain a firm appreciation for mine capabilities. Allowing a soldier to uncrate, arm and detonate the actual munitions will give that soldier more confidence in his ability to accomplish his wartime mission.

The Engineer School maintains that there is no valid reason why engineer units, using proper safety procedures, should be denied the use of live anti-tank mines in training. The risks associated with live mine training are no greater than those associated with infantry "live battle runs" or combined arms live fire exercises (CALFEX). These exercises, like live mine training, require complex coordination and stringent safety procedures.

History supports the Engineer School's position that live mine training is safe. Mine injuries in the recent past have been due to human error. Accidents happen when mine placement or mine arming/disarming procedures are not followed.



Because of this, the Engineeer School is conducting a risk analysis of live mine training. The Engineer School is using a new method that has been developed by the United States Army Safety Center (USASC). USASC has provided assistance in this effort by sending safety experts to the Engineer School to take part in joint work sessions. The resulting proponent risk assessment is the prototype for other schools and posts.

TRADOC and DA are currently reviewing the risk assessment, and initial feedback indicates they will support the Engineer School's initiative.

Some have raised the concern that engineers will train with live mines in ways that create risk. One issue involves the risk of excessive arming and disarming of mines. This may have some foundation, especially with anti-personnel mines, such as the M14. Individual tasks like these will be trained using inert mines, as outlined in the STRAC regulation.

However, mine systems that are unsafe in training should not be used in wartime either. The Army is working to eliminate faulty or dangerous mines.

The Engineer School will recommend, in the final risk assessment, which mines can be trained "live," and how many times a live mine can be armed or disarmed before it is destroyed. These are artificial constraints placed on training, based on the availability of live mines.

Another example of the Engineer School working with the STRAC system involves the use of live anti-handling devices on inert training mines. The Engineer School is proposing that live devices, such as the M1, M1-A1, M3, M5 and M142, be trained with inert activators/boosters. Units would also be allowed to use trip wires.

In the event of error during assembly or disassembly, the flash/bang would come only from the replaceable percussion cap inside the standard. The danger of minor injury is negligible and is offset by the valuable training experience for soldiers.

The Army is developing one universal anti-handling device, the M142, which will ease training and stockage issues. Until all other stocks are depleted, however, the Army must continue to train on all types of anti-handling devices.

Live mine training, including the use of live anti-handling devices, is intended to replicate wartime conditions. It is not intended, however, to replace inert training aids such as the place training mine (PTM) kits. Rather, inert training will prepare soldiers to train with live munitions. Inert training also provides reliable sustainment training.

But there is no good substitution for hands-on live mine training.

STRAC and the CEV

Changes and additions are also being made to the combat engineer vehicle (CEV) gunnery program under the revised STRAC. Until a future generation vehicle, such as the combat mobility vehicle (CMV), is fielded sometime near the turn of the century, the CEV will figure prominently in the future of all engineer operations.

A new STRAC-approved CEV Table V, which significantly improves realism and training value, is scheduled to be incorporated into the next revision of TC 5-117, *Combat Engineer Vehicle Operations.* The old table uses static firing with single engagements, while the new table allows for multiple firing and firing on the move.

Another product of the STRAC program is the XM970, a 40 millimeter (mm) subcaliber device that allows more CEV main gun firing. The device is scheduled to be fielded at Fort Leonard Wood this year and to other units in 1991. While it doesn't duplicate the exact trajectory of regular practice rounds, the XM970, which is shaped like a regular 165mm round, allows excellent realism for a subcaliber device.

Other systems and training devices to be integrated into STRAC in the near future include the Volcano, a multiple-delivery mine system, the Modular Pack Mine System (MOPMS), and the Tactical Explosive System (TEXS). A complete list is in the USAES' Systems Handbook. The handbook, while not distributed Army-wide, is issued to all engineer officers attending their basic and advanced courses.

Smart use of existing ammunition and judicious application of STRAC will result in training strategies that will produce qualified engineers. Become familiar with the STRAC system. If you think there is a need for changes in the allocation of munitions or in the standards for training with them, let us know how you feel. The Engineer School has a good track record for getting the changes needed by line units.

Remember, if you don't ask for changes, then someone will decide that what you already have is sufficient.

Captain Glass serves as chief, Collective Training Branch, Directorate of Training and Doctrine, U.S. Army Engineer School. Previous assignments include platoon leader for the 2d ACR, company commander of B Co, 15th Engineer Bn (CBT), and as the assistant division engineer of the 9th Infantry Division (MTZ). He is a graduate of Combined Arms and Services Staff School and has a bachelor's degree from Mankato State University, Minnesota.

(Personal Viewpoint continued)

commonly used basis in the organization of a command. The geographic area determines the size and nature of assigned forces, and the extent of authority exercised by the commander so that he may implement strategic plans and guidance. The impact of military geography influences the doctrine, organization, materiel, training, and logistics requirements of the forces and the feasibility of different military courses of action.

The Army makes engineers responsible for environmentally related disciplines (topography, hydrology, and environmental sciences) and military construction and related nation assistance. Engineers impose their support on the battlefield and dictate its environment before, during, and after combat. Engineer preparation of the battlefield alters and overcomes the terrain and cultural developments.

We engineers must use the broad scope of military geography in battlefield planning and execution because we will be called upon to restore the environmental infrastructure after the battle. For military engineers, the study of military geography must become as much a part of our professional development as tactical support, engineering design, and project management. We must anticipate the where of the battlefield, and why its environmental character has relevance to the support we give. Engineer terrain expertise must evolve to military geography expertise in order to execute our geographically diverse engineering missions. These missions range from nation assistance in the Americas to combat support and sustainment of the strategic Army force in Southwest Asia.

As the nation's engineer, the Corps of Engineers has an organizational structure to support the battle environment requirements of the Army, joint commands, other military services and agencies, and U.S. foreign military commitments. The Corps can provide operational support through its tactical units, laboratories, and civil works elements.

I propose that the Corps of Engineers pursue a fully integrated environmental mission to formulate and coordinate policy, and to provide direction and oversight of battle environmental support and training to the Army, joint commands, and other DoD services and agencies. Engineers should be trained to apply their military engineering to nation assistance and battlefield environments on a firm foundation of military geography. To do this, I propose that the Engineer School set the example for TRADOC and integrate military geography into our instruction at the basic officer and advanced NCO and officer levels.

Well, that's my opinion. What do you think? The ENGINEER Professional Bulletin and I welcome your comments and curriculum suggestions.

Lieutenant Colonel Robert F. Kirby is the director, Department of Topographic Engineering, U.S. Army Engineer School. Previous assignments include terrain intelligence officer, 517th Engineer Detachment, Vietnam; commander, Company B, 69th Engineer Battalion, Vietnam; commander, 29th Engineer Battalion (Topographic), Hawaii; and topographic programs officer, Office of Assistant Chief of Staff for Intelligence, Department of Army. LTC Kirby holds a master's degree in geodetic science from Purdue University and is a graduate of the Army War College.

Fast-Water Bridging at Night:

High-Risk Training

By Major Randolph L. Hessman

The operation started smoothly and according to plan. An engineer platoon was conducting night rafting operations in fast-moving water. A bridge truck, loaded with a bridge erection boat, backed onto a riverside ramp and parked. The operator put chock blocks in back of the front wheels and set the electric (hydraulic) brake switch. Then he climbed into the boat to prepare it for launching.

Because the truck operator was not on the water and was not yet involved in water-crossing operations, he did not wear a personal flotation device (PFD). He could not swim and was, in fact, afraid of water.

When the soldier moved to the stern of the boat to check a bilge drain plug, the vehicle began to roll. Neither the brake nor the chock blocks held the truck, and it rolled into the water with the boat still secured. Within moments, the force of the water turned the vehicle downstream and broke the port bow tiedown. The boat capsized, and the sinking truck dragged it to the river bottom.

The soldier panicked when he fell into the swiftly moving current. Within seconds a strong undertow pulled him beneath the water, and despite rescue attempts, he never resurfaced.

Analysis

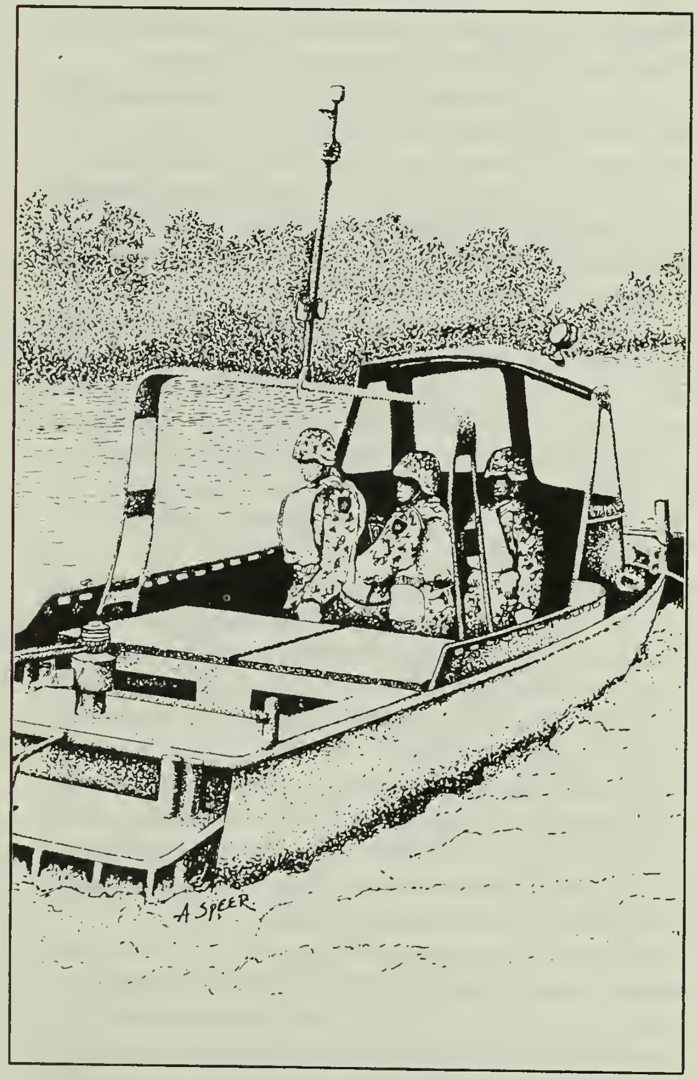
An analysis of this accident determined that several factors contributed to it.

▶ A critical factor was the lack of a PFD on a nonswimmer—a nonswimmer who was afraid of water despite completion of two drownproofing courses.

▶ The electric (hydraulic) brake was disconnected at the time of the accident. The operator did not know this—he pressed the switch and thought the brakes were engaged and holding. Because it positively holds the bridge truck in position during launching and retrieval operations, the brake lock is an important part of the safety system.

▶ The parking brake was not set. Current Department of Army publications are contradictory about the necessity of this requirement. Only the operator's manual for the bridge transporter (TM 5-5420-209-12) requires the use of both brakes.

▶ The chock block placed behind the front wheels could not hold the vehicle on the inclined ramp, particularly when the soldier moved around in the stern of the boat. His movements lightened the load on the front wheels. In addition, the chock block was positioned before the electric brake was applied, giving the false impression that the brake was working.



Although fast-water training is dangerous, personal floatation devices (PFD) can reduce the severity of accidents. PFDs are required any time soldiers (swimmers and nonswimmers) work over water.

The safety boat should be the first craft launched during a bridging operation. A trained lifeguard should remain onboard this boat until all training is completed (U.S. Army photo).

Lessons Learned

Several lessons learned from this accident may help prevent similar ones in the future.

▶ Ensure all soldiers put on their PFDs before climbing into a bridge boat that is either on, over, or near the water. It is especially critical that nonswimmers wear PFDs whenever they are around water hazards.

▶ Designate a PFD control area around all water operation sites, and require that PFDs be worn while personnel are in this zone.

▶ Engage both the electric (hydraulic) and the parking brakes during boat preparation, launching, and retrieval ramp operations. Upcoming changes in technical manuals (TM) will reflect this requirement. In the future, TMs and soldier training products (STP) will describe the electric (hydraulic) brake as the "brake lock."

▶ Do not use chock blocks during launch or retrieval operations.

▶ Ensure that a qualified operator is in the vehicle cab at all times when the truck is parked on an inclined ramp and during launch/retrieval operations.

▶ Check the brake lock (electric [hydraulic] brake) during pre-operation PMCS. Upcoming changes in TMs will add this check.

▶ Designate lifeguards, train them to Red Cross standards, and provide them with rescue equipment. Post a lifeguard with rescue equipment downstream immediately upon arrival on site. Ensure a lifeguard is on the first boat (safety boat) launched.

▶ Develop and rehearse emergency water rescue drills. Contact the Engineer Branch Safety Office for assistance (AV 676-5200/5002 or (314) 563-5200/5002).

▶ Do not expect nonswimmers to help themselves when they enter the water. They panic—even those wearing PFDs. Visually identify nonswimmers with white arm bands, reflective armbands, or chemlites (as visibility conditions dictate). They allow the lifeguard and chain of command to keep track of these soldiers at all times and enable rescuers to find and retrieve them quickly.

▶ Remember, nonswimmers panic. They may not yell for help. They may not hold onto a flotation device, and they may attack rescuers. Nonswimmers may have trouble keeping their heads out of the water even when wearing PFDs. The chain of command should consider these individuals' special needs when conducting water operations.

▶ Reduce the risks associated with fast-water training at night by:

- Verifying equipment operability
- Demonstrating soldier training competency in lighted, calm water conditions
- Ensuring soldiers are in optimum condition (rest, morale, and training)
- Rehearsing rescue operations

A leaf floating calmly on the surface of a river does not reflect the tons of water force that strike a boat or bridge bay when it enters fast-moving water. Swift currents, cold water temperatures, and strong undertows can quickly overcome even the strongest swimmers. Out-of-control boats, bridge bays, or soldiers will be swept downstream and will smash into, through, or under obstacles in their path.

Fast-water river crossings are hazardous, high-risk operations that are critical to the Army's success in battle. Leaders contribute to the success of the entire mission or battle when they take measures to stop water-crossing accidents.

Major Hessman is the Combat Engineer Military Systems Safety Manager at the U.S. Army Safety Center, Fort Rucker.

Obstacle Breaching and Marking For Squads

By Sergeant First Class Bruce Rider

In combat, when units lose the ability to conduct a breach using mine clearing line charges (MICLICs) or mechanical means, forward momentum doesn't have to stop. Both engineer and infantry squads should be trained and resourced to hand-breach and mark minefields and wire obstacles.

The first unit to reach an obstacle must be able to create a breach wide enough to allow assaulting forces to pass through. The lanes must be clearly marked so units do not become disoriented and lose valuable time.

Too often though, maneuver units wait for engineers to clear an obstacle, or engineer squads are short of breaching and marking materials.

What I recommend here is a breaching and marking materials list for infantry and engineer squads. I've based this article on my own experience at the National Training Center (NTC), and on published engineer battle drills.

Before we discuss breaching, we must identify the type of obstacles we are preparing to breach. The NTC Opposing Force (OPFOR) emplaces surface-laid anti-tank minefields with three to four rows. The distance between mines is 4 to 6 meters and rows are 20 to 40 meters apart. Thus the minefield could have a depth of up to 120 meters. The normal density is 550 to 750 mines per kilometer of front. Minefields supporting a fire sack (kill zone) normally have a wire fence on the enemy side, while flank protection obstacles generally do not.

What is the goal of a maneuver unit when it approaches a minefield? Obviously, the unit would prefer to bypass the obstacle, but that is a decision to be made by the unit commander. When a unit bypasses a minefield, both the obstacle and the bypass route must be marked so that follow-on units are not delayed.

If bypassing is not feasible and the obstacle must be breached, FM 5-101, *Mobility*, states that the initial lane must be at least 4 meters wide to accommodate advancing vehicles. Even better is an 8-meter lane, which, given sufficient time, can be developed from an initial 4-meter lane.

At the NTC, an 8-meter initial lane is preferred. The larger lane provides a greater margin of safety, and there simply isn't enough time to come back and expand smaller lanes. After the lane is cleared, it must be marked to ensure the safe and swift movement of vehicles through the obstacle. Again, FM 5-101 calls for units to mark lanes with whatever resources are available. Markers must show the beginning and end of the lane, along with the side limits. Markings should be at least 1 foot inside the mine-free area to provide a safety margin.

There are three methods of breaching conventional mined areas: mechanical, explosive and manual. I will discuss only the manual breach method, using explosives. It requires minimal equipment, and is not as risky or time consuming as using grappling hooks, A-frames, or removing mines by hand.

The primary techniques employed at the NTC are the use of detonating cord ring mains, line mains, or the "pop and drop" method. All of these techniques involve placing a 1-pound block of TNT next to each enemy mine.

The probability of enemy mine detonation is best with ring main, diminishes somewhat with line mains, and is lowest with the pop and drop method. However, the chances of success come at the price of increased material requirements and breaching times.

A breaching kit for the line main method requires at least 150 meters of detonating cord. The line main consists of identical lengths of detonating cord, taped together every 18 inches to keep the cords from separating.

To prepare the cord, place an overhand knot at the end of the line main on which you intend to place the initiating system. Cut 5-meter-long branch lines and tape the ends to prevent moisture from entering the det cord. Use these branch lines to prime the individual blocks of TNT. The line main should be electrically primed for command detonation, with a backup non-electric system.

To carry the line main, roll it back on the reel in which the det cord was delivered, or use the DR-8 and reeling machine you use for blasting wire. Before packing them away, prime each of the TNT charges with det cord. Wrap the cord around each block to prevent it from becoming entangled.

The ring main is prepared much like the line main. Prepare the TNT charges the same way. Keep the det cord on the shipping roll. After arriving on site, lay out the cord and cut it to the length you need. This will prevent kinks from getting in the line. As with the line main, use an electric initiating system so it can be command-detonated, and a non-electric system as a back-up.

The favorite method of emplacement at the NTC is the pop and drop. The pop and drop is not recommended by the Engineer School because of safety concerns and its somewhat diminished effectiveness. While this method is very dangerous, it is faster than forming a ring or line main, and can be extremely useful in critical tactical situations.

To make pop and drop (or individual assault) charges, the TNT should be primed with a non-electric cap, 2.5-3 minutes of time fuse, and an M60 fuse ignitor. The time fuse should be wrapped or taped around the TNT to prevent the time fuses from getting tangled together. (*Author's Note:* Although beyond the scope of this article, an excellent reference for the organization and execution of the pop and drop drill is *Sapper Techniques II,* dated August 1988, and published by the Engineer School).

With an OPFOR minefield density of 0.75 mines per meter of front, the average number of mines in an 8-meter-wide path is six, with a maximum of eight.

A carrier for eight charges can be made from an M25A1 protective mask carrier, or an M18A1 claymore mine bag.

A basic squad-sized demolition kit for manual breaching of surface-laid minefields should consist

An engineer squad member, foreground, participates in a breaching operation during field exercises at the National Training Center (NTC), while umpires look on (U.S. Army Photo).

of the following:

- 50 1-pound blocks of TNT
- 1 1000-foot roll of det cord
- 100 feet of time fuse
- 20 fuse ignitors
- 5 electric caps
- 20 non-electric caps
- 20 fuse adaptors
- 2 M18A1 claymore mine bags or M25A1 mask carriers
- 2 DR-8 reels with reeling machine and detonating wire
- 1 M35 blasting machine
- 2 crimpers
- 2 pliers with side cutters
- 1 roll of electrical tape
- 1 roll of cloth tape

This package will allow at least two breaches using any of the three methods.

To provide the signature of a deliberately laid minefield, the OPFOR places either single or double concertina on their side of the minefield. If you need to cut this wire, use grappling hooks to shake the wire first to check for booby traps. The NTC OPFOR has become particularly adept at using grappling hooks. They will attach 25 feet of 1/8-inch wire cable, 1-inch-diameter rope, or 1/16-inch-diameter chain to their grappling hooks, and attach the other end to their vehicles. The hooks are thrown over the wire, and the vehicles pull it away from the breach site.

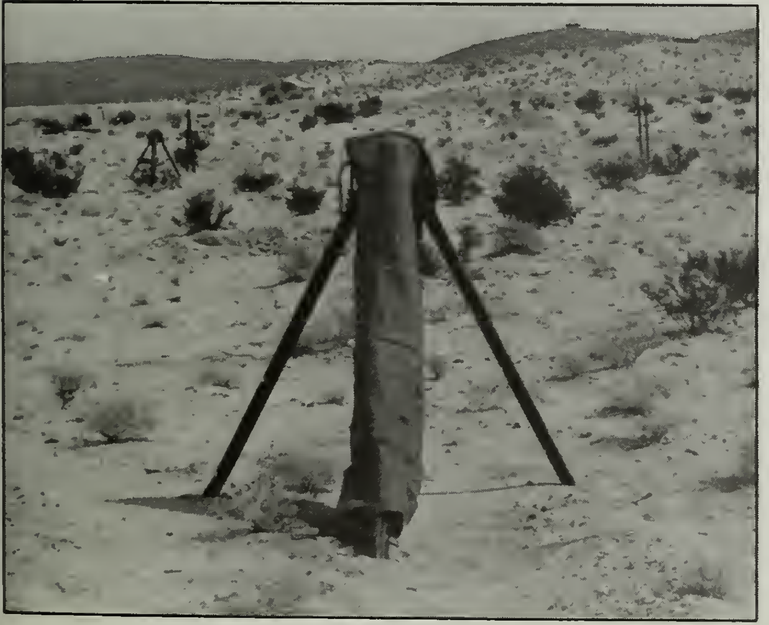


Figure 1

This method of breaching will normally take from 30 seconds to 1 minute. Since there is always the chance that wire obstacles may be booby trapped, additional tools are needed to facilitate breaching. Each squad should carry:

- 1 pair of bolt cutters
- 2 wire cutters
- 2 grappling hooks
- 100 meters of Marline or parachute cord

Terrain is a major factor in deciding which kind of lane marking system to use. It's essential to have a system that can be easily identified by the assaulting and follow-on forces. I will explain the types of marking systems that have been effectively employed by units during their training rotations at the NTC.

Tripod with VS17 Panel. The tripod (Figure 1) is formed by bolting three long, U-shaped pickets together. The pickets are spread apart to form a tripod base, with the bolted end at the top and one leg facing the friendly forces. Attach the VS17 panel to the top and bottom of the leg on the friendly side of the tripod. To mark the lane, place the tripod on either side of the entrance and exit of the breached lane. This system is good on flat or raised terrain.

Engineer tape or Hand Emplaced Mine Marking System (HEMMS) marking tape. Tape is good for marking the limits of the breached lane. The most effective technique is to use multiple strips to delineate the right side from the left. Use two strips of tape on the right side, and one on the left. The tape should be attached to the entrance and exit markers at waist height.

Nine-foot pole with 2x2 yellow marking flag. The pole is constructed using three camouflage net poles, with a 2 foot by 2 foot yellow marking flag attached at the top. To support the pole, a 4-foot metal rod (a generator grounding rod is recommended) is driven into the ground about 2 feet. The poles are placed over the top of the rod. Any flag larger than 2 feet by 2 feet will cause excessive strain on the anchoring rod, causing it to bend in windy conditions. One unit put this setup to good use by grouping three poles, 100 to 200 meters from their breach. This provided a larger visual signature for approaching units. This system is good for rolling terrain and brushy areas.

Pyrotechnics. Colored smoke at the entrance and/or a colored star cluster can be used to tell the unit the breach has been completed. Because pyrotechnics dissipate quickly, it's necessary to keep firing these until all units are through the breach.

I recommend that a combination of these marking systems be used (Figure 2). To initially mark the breach, place the tripods with the VS17 panels at the entrance and exit. Pop a colored smoke grenade to mark the entrance. This will allow the assault force to move through the breach. The squad should continue to improve the lane by marking its limits with engineer tape. The flag poles should be placed 100 to 200 meters from the entrance to the lane. Star clusters should then be fired to direct units to the area of the breach. Colored smoke should then be continuously employed to mark the lane entrance.

Night and limited-visibility conditions present unique problems in identifying the lane. The tripod system can still be used, but a visible light source is needed to attract vehicles at night.

Chemlights or flashlights. The entrance and exit should be marked using a color code. The entrance should be marked on both sides with green lights, and the exit with blue. This will reduce any confusion as units approach the breach. Remember, chemlights fade over time and are designed for varying durations. With night

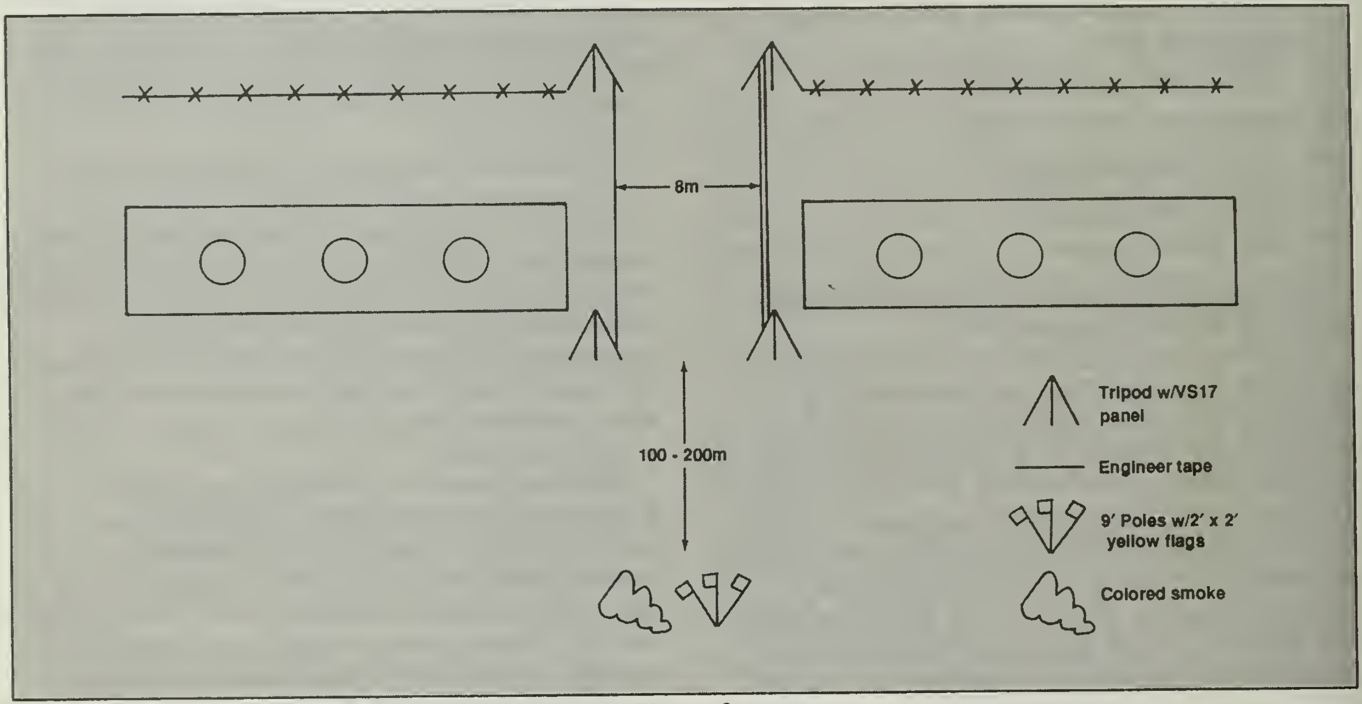


Figure 2

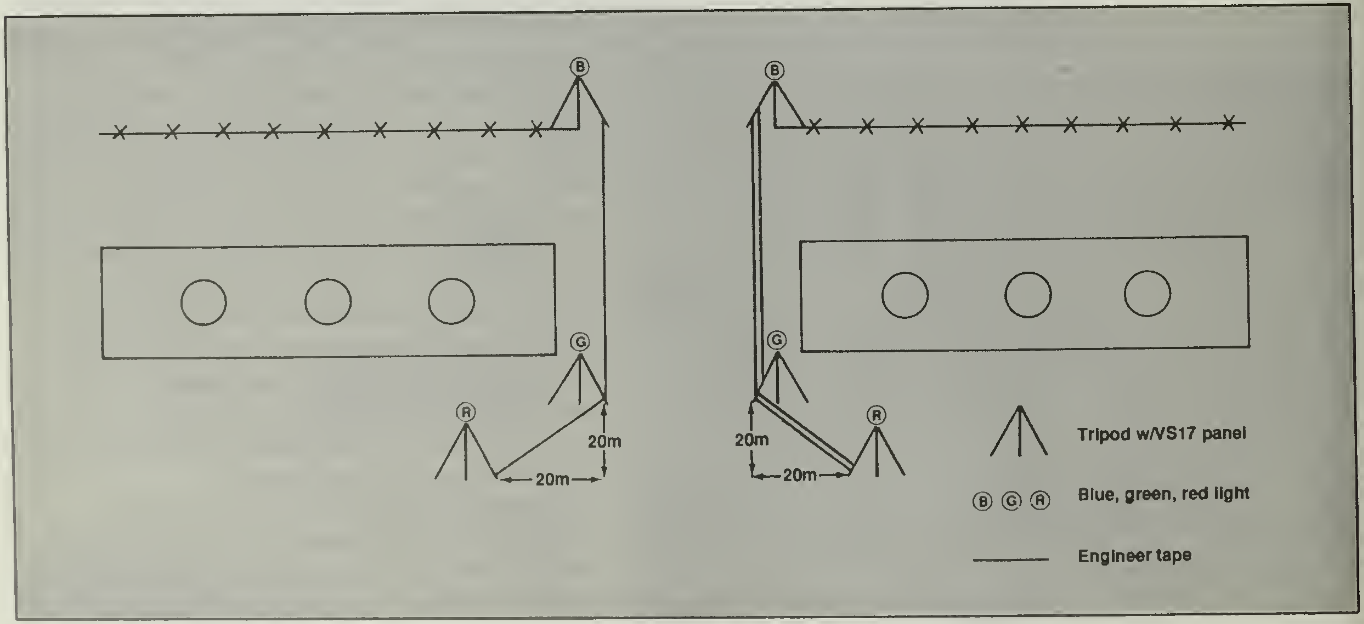


Figure 3

visibility at 50 percent or less, the lights can be seen up to 1 kilometer (km) away. A flashlight retains its brightness for up to 8 hours, and can be seen for 1 to 3 km depending on the terrain. Both chemlights and flashlights can be used as directional signals that cannot be seen from the enemy side. Remember, colors cannot be distinguished when wearing night vision goggles. A possible solution for this is to use multiple lights on the right side, and only one on the left.

Road flares. These flares last 20 minutes or longer, depending on the length of the flare. Because of its very bright, omnidirectional light, these flares work best during smoke operations or fog. Otherwise, they tend to expose vehicles to enemy fire at night.

For low-visibility situations, the best arrangement is to combine the flashlights with the tripod marking system (Figure 3 on page 32). Once a lane has been marked with the tripods, place blue or green tinted flashlights to mark it. At the entrance, place additional tripods 20 meters to the side of the lane on the minefield side, and mark these with a red flashlight. Mark the lane with two strips of engineer tape on the right, and 1 strip on the left. Smoke can obscure the lane, so also consider using a colored star cluster to mark the breach site.

The materials and techniques covered here should allow any engineer or infantry squad to breach and mark minefields and obstacles. The use of rehearsals for units from squad level through task force will ensure that a unit will be able to make a successful breach.

Even without MICLICs or mechanical clearing assistance, a well-trained squad should be able to clear the way and allow assaulting forces to maintain the momentum of the attack.

Sergeant First Class Rider is the engineer individual skills trainer for the 177th Armored Brigade (OPFOR) at the National Training Center. He has served as the brigade's operations NCO, and as a platoon sergeant in 42 maneuver training rotations at Fort Irwin.

The ENGINEER Writer's Guide

We think engineers take a special pride in their profession, and *ENGINEER* is always looking for articles from readers who want to share their expertise, experience and ideas.

If you're a potential contributing writer, here are a few "writer's guide" tips that should help steer you in the right direction:

Articles can cover engineer training, operations or doctrine, engineer equipment, history, or other areas of general interest to an engineer readership.

We're especially interested in articles that have a "how-to-do-it-better" theme. For instance, we're not looking for articles telling readers how you conducted a routine field exercise. But if you think you have a "new-and-improved" way of conducting a tactical operation, training exercise, or other operational procedure that may prove helpful to other engineers—that's what we need.

Articles should generally come from contributors with first-hand experience with the subject being presented.

Avoid theatrical writing styles like: "It was a dark and stormy night...," or "...the soldier blazed through the jungle on his lumbering D7, providing a trail of freedom for the other vehicles...."

Articles should be concise, straightforward, and in the active voice.

Length should range between 2,000 and 4,000 words, and the text should be typewritten and double-spaced. Generally, each such page will contain from 200 to 250 words.

Articles containing attributable information or quotations not referenced within the story should carry appropriate footnotes.

Manuscripts must be original, unpublished, and not under consideration by another publication. Normally, you can expect a reply to your submission within two weeks after we receive it.

All submissions are subject to editing.

Contributors are encouraged to include black-and-white photos, artwork, and/or line diagrams to help illustrate your article.

Include your full name, rank, current unit and job title. Also include a list of your past assignments, experience and education, your mailing address, and daytime phone number—preferably Autovon. Send your articles to: Editor, *ENGINEER Professional Bulletin*, ATTN: ATSE-TDM-PB, Fort Leonard Wood, MO 65473-6650.

If you have any questions about an article you're working on—or considering writing—give our features editor, Phil Howell, a call at Autovon 676-7532, or commercial (314) 563-7532.

We look forward to hearing from you.

P.S.* ENGINEER *is planning to start a Letters to the Editor column soon, and correspondence from our readers is welcome.

ARTEP Mission Training Plans:

Making Life Easier

Mission training plans (MTPs) can make your life a lot easier, particularly if you're an engineer unit leader.

How many times have you had the experience of trying to fill out your unit's training schedule, and you just can't think of anything new or interesting to put on it? The operations sergeant wanted it yesterday, he's already called twice today, and the only thing you've got on the form so far is PT at 0600 every morning.

You're lost for ideas. Your unit seems to be in a rut, training on the same events every three months or so. It seems the only place to find ideas is a stack of old lesson plans.

Maybe it's time for the aspirin. Or maybe you can use an MTP for assistance in conducting your training program.

Out With The Old

MTPs are manuals which assist soldiers and leaders in line units to successfully train on collective tasks. Both the "ARTEP MTP" name and format are new. In 1989, the Engineer School published the first MTPs for the combat engineer battalion, company and platoon, and for the airborne/light/air assault combat engineer battalion, company and platoon. The chart on page 35 shows the manuals already published, and those scheduled to be published in FY91 and FY92.

The MTP manuals were previously referred to as Army Training and Evaluation Program (ARTEP) manuals. They were bulky and cumbersome to use. Unit trainers seldom used them, except when it came time for the battalion's annual ARTEP exercise. Then they were dug out from the bookshelf, dusted off, and grudgingly used for a couple of weeks.

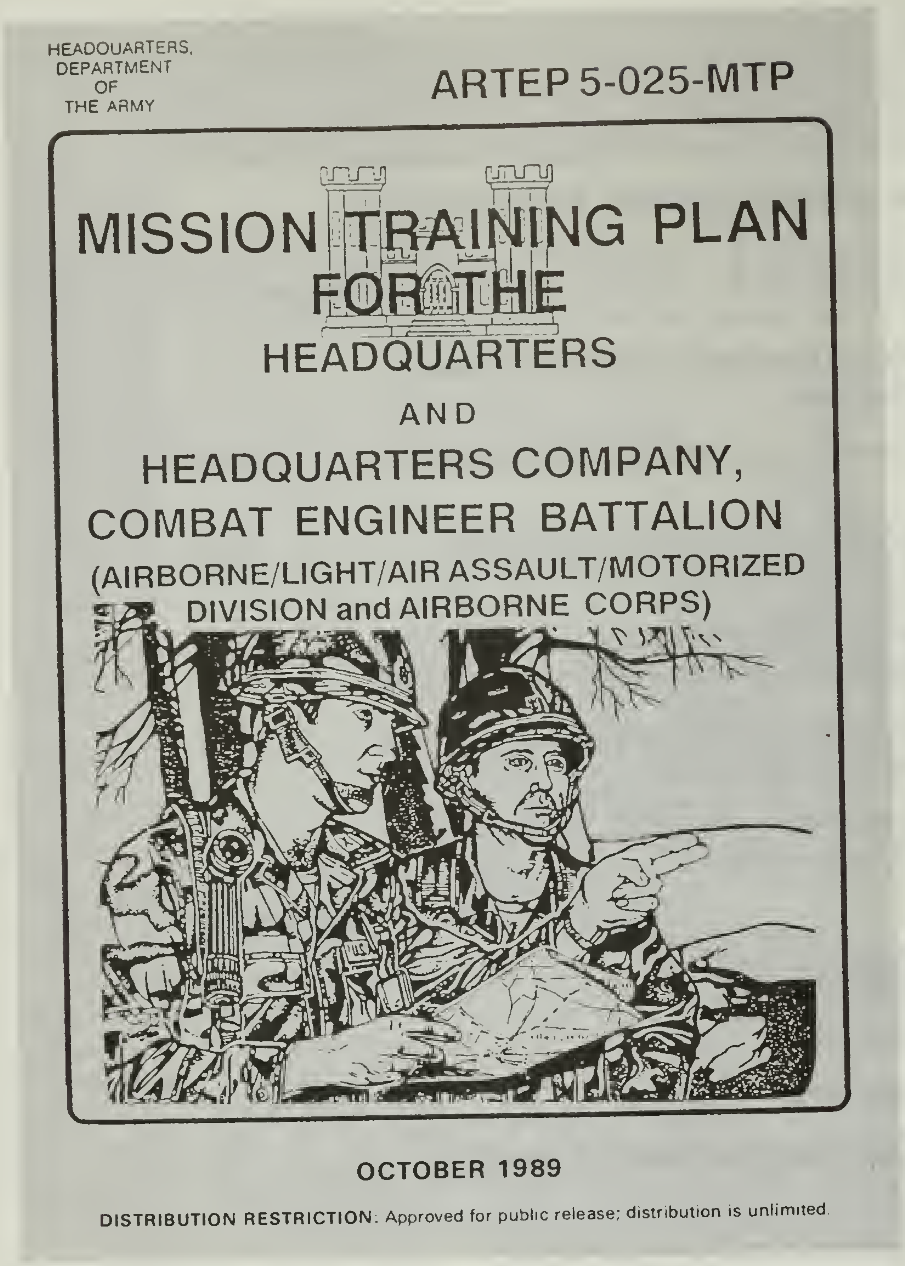
In the past, companies spent valuable time conducting "ARTEP train-up" exercises on those things that the Mission Essential Task List (METL) said you needed to know to succeed in your wartime mission. Then you deployed to the field, with ARTEP evaluators hot on your heels for the duration. Your company and battalion "did their thing," and got an "attaboy" from the battalion commander.

Another year and another ARTEP exercise successfully completed, according to your evaluators (whose battalion you are scheduled to evaluate next month). But did your unit really get any good training from the exercise?

By Captain Robert C. Kurtz

Engineer ARTEP Mission Training Plans

MTP	Title	Publication date
5-145-MTP	Headquarters and Headquarters Company, Engineer Battalion, Heavy Division/Corps	Feb 89
5-145-31-MTP	Engineer Company, Heavy Division/Corps/Armored Cavalry Regiment	Feb 89
5-145-11-MTP	Combat Engineer Platoon, Heavy Division/Corps/Armored Cavalry Regiment	Feb 89
5-025-MTP	Headquarters and Headquarters Company, Combat Engineer Battalion (Airborne/Light/Air Assault/Motorized Division and Airborne Corps)	Oct 89
5-025-31-MTP	Combat Engineer Company, (Airborne/Light/Air Assault/Motorized Division and Airborne Corps)	Oct 89
5-025-11 MTP	Combat Engineer Platoon, (Airborne/Light/Air Assault/Motorized Division and Airborne Corps)	Oct 89
		Planned date (FY)
5-145-DRILL	Engineer Drills	91
5-145-32-MTP	Engineer Bridge Company	91
5-145-12-MTP	Engineer Bridge Platoon	91
5-415-MTP	Headquarters and Headquarters Company, Engineer Battalion (CBT) (HVY)	91
5-415-31-MTP	Engineer Company, Engineer Battalion (CBT) (HVY)	91
5-415-13-MTP	Construction Equipment Platoons, Engineer Battalion (CBT) (HVY)	91
5-415-14-MTP	Maintenance Platoon, Engineer Battalion (CBT) (HVY)	91
5-415-15-MTP	Equipment Support Platoon, Engineer Battalion (CBT) (HVY)	91
5-415-17-MTP	Construction Platoon, Engineer Battalion (CBT) (HVY)	91
5-605-MTP	Headquarters and Headquarters Company, Engineer Battalion (CBT) (HVY)	92
5-605-31-MTP	Engineer Company, Engineer Battalion (TOPO)	92
5-605-11-MTP	Engineer Platoon (TOPO)	92



HEADQUARTERS,
DEPARTMENT
OF
THE ARMY

ARTEP 5-025-MTP

MISSION TRAINING PLAN
FOR THE
HEADQUARTERS
AND
HEADQUARTERS COMPANY,
COMBAT ENGINEER BATTALION
(AIRBORNE/LIGHT/AIR ASSAULT/MOTORIZED
DIVISION and AIRBORNE CORPS)

OCTOBER 1989

DISTRIBUTION RESTRICTION: Approved for public release; distribution is unlimited.

The old ARTEP manuals had other problems as well. The training standards for the tasks were long and tedious to read. The manuals were hard to use and understand, which made the training process unnecessarily difficult.

Better Guidance

The new ARTEP MTPs don't have these problems. The MTP is a lot more user friendly than the old ARTEP manuals. Their purpose, as the preface in each MTP states, is "to provide a descriptive, mission-oriented training program to be used as a guide to train the unit to perform its critical wartime missions." The MTP provides better guidance for leaders on how to successfully complete a meaningful ARTEP exercise at platoon, company or battalion level.

Training and evaluation outlines (T&EO) make up the vast majority of each MTP. They are the outlines of the collective tasks which have been deemed critical for your particular type of unit. These collective tasks were compiled from comments from the field, and by executive committees convened at the Engineer School.

Each T&EO has a number to distinguish it from other branches and from other T&EOs within each branch. The first number identifies the branch that is the proponent for that collective task. Engineer collective tasks begin with number 5. The second number stands for the unit level at which this task is performed and evaluated. Number 1 is for battalion, 2 for company, 3 for platoon, 4 for squad, and 5 for team/section. The last four numbers represent the unique collective tasks.

The T&EO explains exactly, step by step, what you need to successfully train your unit on a given task. Many junior leaders have had to write an outline for each training event, and then determine the training, resources and time required to support it. Well, the MTP takes care of all that for you.

In each T&EO, the element, task, condition and task standards are identified for each collective task. After the task standards, the T&EO lists all the steps required to successfully complete that collective task. It is nothing more than a lesson plan on how to teach and train that task—all laid out for you in an easy-to-follow format.

At the end of each T&EO, there are two items that will greatly assist trainers: individual task references, and opposing force (OPFOR) tasks/conditions/standards. Listed here are the individual soldier and officer tasks that support the T&EO. This feature allows trainers to go directly to the Soldier Training Publication (STP), and the Military Qualification Skill (MQS) Manual, to find the individual task steps which support the collective task. The OPFOR tasks/conditions/standards allow trainers to put their unit against an OPFOR element to form that collective task under pressure.

The new MTPs also have sample situation training exercises (STX), which are a collection of T&EOs wrapped into a field training exercise. An STX is a platoon- or company-level exercise that lasts up to 72 hours. The sample STX provided in the MTP is set and ready to go and includes such things as a proposed time line and suggested resource requirements. The STX can be used as is, or modified by unit trainers as they see fit.

Getting Better All The Time

Future MTPs will contain several innovations which will make them even more useful training aids to the leader in the field. The addition of OPFOR tasks/conditions/standards will allow units to more fully test their ability to perform combat missions. Additional emphasis on integrating nuclear, biological and chemical (NBC) skills into training, and a more extensive individual soldier task list at the bottom of T&EOs should further increase the usefulness of MTPs.

In early FY91, the Engineer School will publish a drill book which lists all drills a combat engineer, an engineer vehicle crewman, or a bridge crewman might use. A drill is a critical action a small unit conducts as part of a collective task. The drill manual will be pocket-sized, which should make it easier for the average soldier to use. The Infantry School also publishes a drill book that provides engineer soldiers with valuable information on basic combat skills.

The MTP should prove to be a valuable tool for engineers. It is one way to train—but it's not the only way. It is a foundation that must be modified for each engineer unit, based on the commander's mission essential task list (METL) and that age-old acronym, METT-T (mission, enemy, troops, terrain and time). The Engineer School plans to revise and re-issue MTPs every five years, or earlier if warranted. Questions or comments concerning MTPs can be mailed to Commandant, U.S. Army Engineer School, ATTN: ATSE-TDU-C, Fort Leonard Wood, MO 65473, or by calling the Collective Training Branch at Autovon 676-7784/7786 or commercial (314) 563-7784/7786.

Captain Kurtz is a training analyst with the Collective Training Branch, Directorate of Training and Doctrine, U.S. Army Engineer School. He previously served as a platoon leader, mobility/countermobility platoon leader, company executive officer, and assistant S-3 for the 16th Engineer Battalion. He is a graduate of the Engineer Officer Advanced Course. He holds a bachelor's degree in civil engineering from Purdue University, and a master's degree in civil engineering from New Mexico State University.

Engineer Problem

Your platoon has been tasked to emplace a 500 meter (m) row minefield with a density of 0.75-0-0. You have decided to space the mines 6 m apart. Determine the number of M15 mines to order and the number of 5-ton dump trucks required to deliver the crated mines.

Reference: FM 20-32

Engineer Solution on page 44.

Hedgehogs:

Iron Animals For Engineers

By Captain John H. Breidenstine, Jr.

Well, you've seen your engineer company put up a vast array of training obstacles during this particular ARTEP, and you're proud of what your soldiers have done. The "enemy" advance is expected any time now, and you're in a vantage point to watch them try to make it through a particularly critical mountain pass. You and your men have put a day and a half of work into carefully covering the pass with training minefields.

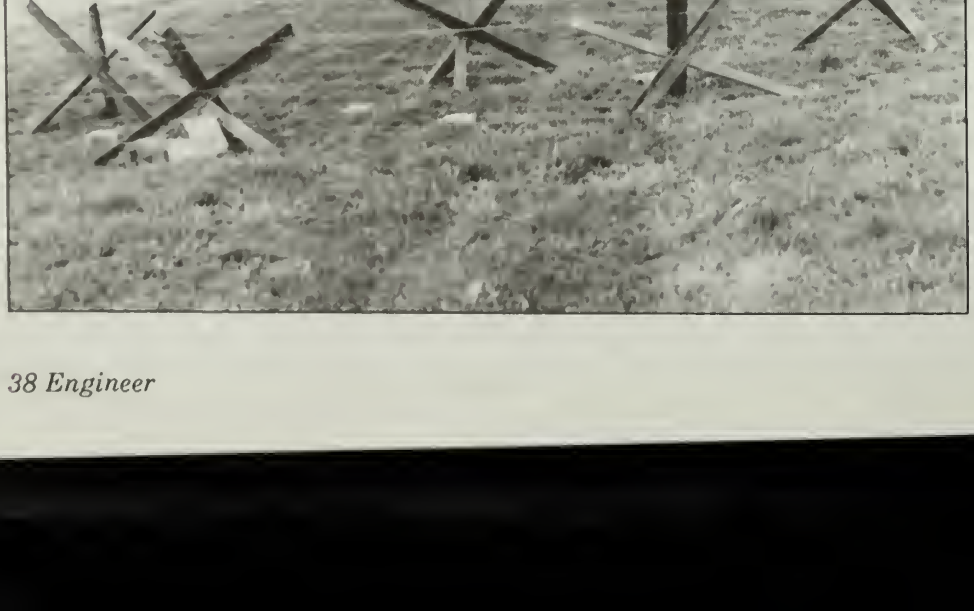
Now you can hear the roar of the lead vehicles of the infantry task force as it edges through the pass—and right through one of your "minefields." There are no umpires to be found anywhere, and the enemy charges on to outflank your own task force.

Ever wish you had something a little more substantial to put in the way of the opposing force during field exercises?

The answer may lie in the hedgehog, a training device that resembles a giant toy jack. Used by the 130th Engineer Brigade strictly as a training aid during maneuver exercises, the hedgehog has proven its worth in adding a significant amount of realism to engineer field training.

The hedgehog is a relatively simple design that consists of three pieces of 2-meter-long angle iron, and is assembled with bolts. Assembly consists of spreading apart two angle irons that are already bolted together into the shape of a cross, and then sliding the third leg into position to form the "toy jack" shape. The three are then bolted together. Each hedgehog weighs about 250 pounds, depending on the size of the angle iron.

The hedgehog is a highly visible device that requires



Hedgehogs being used to block an open field in Germany during a Reforger exercise. Such an obstacle, reinforced with barbed wire, takes a combat engineer squad of seven men about two hours to assemble and install (U.S. Army photo).

manpower not only for installation, but for removal as well. It's also "nestable," so large numbers of them can be easily stored in a relatively small space. Too, the "hog" provides the bulk weight required to simulate the amount of Class IV and V barrier material that would be needed by a combat engineer unit.

A combat engineer squad of seven men requires about two hours to assemble and install five such devices (including supporting barbed wire) on a standard-sized road. This five-hedgehog obstacle, nicknamed HEX, weighs about 1,250 pounds. A squad can transport two complete HEX obstacles on a trailer.

Additional equipment required includes several sledge hammers and crescent wrenches. Ideally, a cable should be run through the ends of each hedgehog and securely anchored at each end of the obstacle. This adds to the "enemy's" difficulty in removing it. Barbed wire should be liberally employed in and around the HEX to help deter manual breaching.

While not designed for wartime use, hedgehogs can serve as a valuable training obstacle. The best use of the device is probably as a good countermobility obstacle that would effectively channelize the enemy. They have sufficient weight and volume to discourage manual breaching, and combined with minefields and wire obstacles, they make for an effective and challenging training scenario.

Some of the hedgehog lessons learned by the 130th include:

- The devices are very manpower intensive and are an excellent engineer obstacle emplacement training drill.
- They can't serve as obstacles by themselves, but need to be supplemented by minefields, wire, or booby trap devices to reinforce their effectiveness.

Combat engineers bolt together pieces of angle iron to form a hedgehog. While not designed for wartime use, hedgehogs serve as valuable training devices (U.S. Army photo).

- Like all obstacles, they must be tied into natural terrain features to be effective.
- A disadvantage is that the hedgehog, once disassembled, is fairly easy to transport and install. Once an enemy has cleared the obstacle, it would be a simple matter for him to use it against you.

In conclusion, it needs to be restated that the hedgehog is not suitable as a wartime obstacle. It is, however, an extremely effective obstacle device that can serve your unit well in countermobility training. Give it a try. And you won't need an umpire to tell your ARTEP opponent to stop for an obstacle.

Captain Breidenstine is commander of C Company, 54th Engineer Battalion. He previously served as the assistant adjutant of the 130th Engineer Brigade. He has also served as a platoon leader. He is a graduate of the Combined Arms and Services Staff School and Engineer Officer Advanced Course.

The Command Sergeant Major

As Seen By The Battalion Commander

By Lieutenant Colonel Herbert F. Harback

Much has been said about two critical "command teams," the commander and his spouse, and the commander and his subordinate commanders. This article focuses on a third team, seldom written about but more important than the other two. It is the commander and the command sergeant major.

The halls of both officer and NCO clubs are filled with "war stories" of past tenuous commander/command sergeant major relationships. "Would have been better off without him!" "I had to do both jobs!" "He had no idea how to handle it!" These comments sum up some of the things said by both parties at one time or another.

Forming the Team

In spite of an awareness that such disconnects may exist, there still remains a void of academic guidance, field-tested procedure, and sage advice.

Both commander and command sergeant major, more often than not, find themselves "assuming" more than actually talking. Particularly when it comes to their responsibilities to one another and to the unit they serve. Seldom written about, yet key to any success their soldiers are to enjoy, the commander/command sergeant major team is not an easy one to form or sustain.

The letter which follows is one commander's view of how that relationship should be. Each time I have formed up a new command team, I have prepared such a letter for my command sergeant major. Given on the first day and informally updated on a monthly basis, it is the start of an open partnership. Although the words may change with time, and as each new team forms, the basic philosophy of command and the senior enlisted leader's role in that relationship remain the same.

The Starting Point

Five key points provide the interlacing for the team's flexibility and strength. First, responsibilities must be clearly spelled out in order to establish focus and efficiency. They also serve to provide accountability.

Secondly, the commander must understand that his command sergeant major has been successful not being an officer, and that there exists two separate and distinct career patterns. The commander may not want to be an NCO, but neither does the command sergeant major want to be an officer.

The third point is an open dialogue. Easy to say, but hard to do. Every workday there must be a huddle of the two leaders. No matter how great one may think the team is going, daily azimuth checks are needed.

Next, be honest and talk through the bad—as well as the good—days. In most cases, both commander and command sergeant major are about the same age and time-in-service, and are going through many of the same feelings. Share them in order to form a bond of trust and honesty.

Finally, there is only one commander. He must not abdicate his authority or responsibilities. He must cooperate and delegate. The commander needs to respect the command sergeant major, for he is—like the commander—only one soldier deep. Neither must be placed in a position of failure or isolation. Together, the commander and the command sergeant major form the unit's true command team.

Here is my letter:

MEMORANDUM FOR:
Command Sergeant Major

SUBJECT:
Responsibilities of the Command Sergeant Major

1. Our relationship is the single most important factor in the success of the battalion. As a team, things will click and the spirit of the battalion will be high. If we are not in harmony, there will be needless confusion and damaging frustration. The purpose of this letter is to provide to you my thoughts, expectations and initial guidance.

2. Much time was spent in developing of the 14 command policy memos. I need for you to understand each one and to enforce them wherever you go. I see your range of operations covering all parts of the battalion. Your presence should be known and sought, not avoided or feared. I consider you my main counsel and a major mentor for both NCOs and officers. I do not expect you to be with me at all times. I see us as a team, split to cover more area, but speaking with one voice. I anticipate getting together at least twice a day to discuss our sensing as to where the battalion is, and what our actions will be to keep the battalion at its cutting edge of readiness.

3. As a key leader, you need to understand the NCOs and officers—their needs, goals and responsibilities. You are not an officer candidate, you are the senior NCO of the battalion. You possess a great deal of experience which must be shared with both NCOs and officers. You are the chief advisor in CTT and engineer skills. You are the person I turn to for ITEP, NCOES, squad proficiency, schools, marksmanship, physical training and soldier certification programs. I expect for you to be an expert in all of these areas. Become personally involved in our support to Fitch School, the battalion's Developmental Physical Readiness Program, the implementation of the monthly soldier, and the new EER counseling systems. In addition, I need you to inspect the companies—their formations, training, billets, retention activities, and motor pool operations. Do not spend the bulk of your time on specifics. Rather, dedicate yourself to checking on soldier development and leadership. Meet with and work with the first sergeants and the senior staff NCOs. The battalion will rise or fall based on the caliber of leadership we find at the NCO leader levels. You are the key player in this endeavor.

4. First impressions are lasting ones and are very important. A good first impression allows us to call our own shots, keeps the established momentum going, and permits us to train as we had planned. A bad impression brings a lot of outside onlookers, uninvited inspections, and general confusion. First impressions start with the appearance of the battalion headquarters (inside and outside) and company areas. They continue with the way the soldiers act, salute, dress, train and project a solid warrior spirit. I need your help in these areas. When a person comes by, he should know he is in combat engineer country! "*Rugged*" was the motto of our regiment, and it is our motto. It is that feeling of being among professional soldiers—*rugged*. Top-notch troopers should jump out in what people see and how we feel about ourselves. Our battalion history is very important. It gives to the soldiers a common heritage and direction. It provides roots. I need for you to inculcate this positive spirit into ALL of our soldiers. Soldiers and their equipment must be in top shape, on the ready line, and leaning forward—combat ready, anytime, anywhere.

5. I look to you, as the senior NCO, to be the role model for all junior NCOs. That means you must constantly possess the values and standards of a professional leader. Your focus must be on the mission, and on the soldiers and equipment which will do the mission. Standards of conduct and readiness which you must display require exacting states of physical, mental and moral strength. You need to be totally involved in all missions which impact upon the soldier and his family—be it PAC activities, post support, field exercises, battle drills or reenlistments. I am very concerned with sole parent issues, family unrest and the proper care of the soldier and his equipment. Who is he? How is he? Where is he?

These are the three questions I want you to constantly push on all leaders in this battalion. Help me train the good leaders, and weed out the substandard ones. Our soldiers deserve only the best in leadership.

6. I have mentioned a number of items in the paragraphs above. Let me highlight the top five issues I need for you to begin work on now as you develop programs on the other points.

a. Command policy memos. Know them, implement them at all levels and at all times—starting now.

b. Upgrade of company and billet areas. We need a first class, rugged, combat soldier area of operations. No matter what the MOS, every soldier is a combat warrior. Get a winning, battle-focused spirit going in all we do and in how we look and feel. Take special time and effort in keeping the soldiers of the 761st as 100 percent members of the battalion team.

c. ITEP, NCOPD and NCOES. Get them off center and moving. Don't accept excuses when it comes to soldier skills, physical fitness, and SQT scores, as well as training, counseling and marksmanship programs. Low-density MOS training needs your immediate attention. METL focus and FM 25-100 must be the central theme of our NCOPD.

d. Power down. Place the focus at the lowest level of leadership and allow that leader to lead soldiers as he develops himself. Get accountability lined up with authority and responsibility. Make the training programs real. Hold the trainers' feet to the fire. Concentrate on CTT and battle drills. Be the advisor to officers as well as NCOs. You have the experience to help both groups. Counsel every new officer on the role of the NCO, and how to be a leader. Set up a program of transition from soldier to NCO for all promotable specialists and recently promoted sergeants.

e. Standards. Enforce them. Leaders live them all of the time. Accepting substandard performance, conduct or appearance means that we have a substandard leader who, if allowed to continue, will bring our battalion to a nonmission-capable status. Push bars on the substandards—the profile riders, the overweight and out-of-shape soldiers, the shammers, the drug users and all the others who can't cut it. Instill a battle focus in all of our actions, and total combat readiness in our soldiers and their equipment. This task force is to continue to be the hallmark of professional standards—from head to toe in all we are about and do. That includes garrison, motor pools, training areas, and on the battlefield.

7. In order to do all that I have mentioned, you and I must be a team. We need to be where the action is, anytime—day or night—throughout the whole week. We need to anticipate and assist. Above all, we must lead by example here and down range.

Where are we now? I know we have a superb battalion with strong leaders and solid soldiers. I also feel that standards need to be continually stressed. Basic field skills need help. We must also maintain a full court press on sustaining a combat focus of readiness (physical, mental and moral) in our daily operations.

8. I look to you as my partner in these efforts. If you feel any doubts about this relationship, now is the time to discuss them. We are on a fast train, and tomorrow is too late. The soldiers and junior leaders need us now. This letter is my initial counseling to you and will be the focus of our next meeting.

9. *Rugged!*

Herbert F. Harback,
LTC, EN
Commanding

Beyond The Letter

It's a start. Without this charter there can be no sense of responsibility or focus. Both the commander and the command sergeant major need to understand each other and how they will function together as a team. This letter begins that process.

But more important is what lies beyond the letter. A command will have unlimited potential if the commander and command sergeant major team takes the point and leads the unit to new levels of readiness.

Lieutenant Colonel Harback is the commander of the 14th Combat Engineer Battalion (Corps), Fort Ord. He has served in various command and staff positions, including executive officer, Bayonet Combat Support Brigade, 7th Infantry Division (Light); deputy commander, 7th Engineer Brigade, VII Corps; S-3, 7th Engineer Brigade, and aide-de-camp to the commanding general, U.S. Army Western Command.

Revised MQS System Will Enhance Officer Training

By Captain Jonathan M. Williams
and Captain Thomas G. Young

The Military Qualifications Standards (MQS) System is undergoing a complete revision designed to improve its value as an officer training tool.

Previous MQS manuals have met with criticism from the field because they were too long and troublesome to use. To improve their usefulness, Training and Doctrine Command (TRADOC) directed that the system be revised.

Since that guidance was issued, all MQS products have been scrutinized and are under various stages of revision. The Engineer School is currently revising its branch MQS manual and expects to distribute the new product by January of next year.

The MQS system provides commanders with an important tool for structuring a comprehensive professional development program. It outlines critical tasks for officers, while allowing commanders to tailor the program to their unit's mission essential task ist (METL).

The MQS lists the critical common tasks and professional knowledge subject areas within each task. The tasks are also identified as to their training location resident versus nonresident). The system serves as a convenient assessment tool, allowing the commander to provide feedback to unior officers on their progress.

In April, the Engineer School conducted a selection board to determine which engineer-specific tasks would be included in the branch guide. The board had instructions to keep the manual short and concise, and avoid duplication between the branch guide and the common guide.

Both the branch and common guides contain task summary sheets (TSS). These are not meant to provide comprehensive "how to" guidance, like enlisted soldiers' manuals, but are intended to provide training outlines. As a separate, parallel effort, training support packages (TSP) are being developed which support each task with detailed information. Each TSP will be a "stand-alone" product which should give the trainer all the resources necessary to conduct training on a specific task.

Upon completion of the MQS development effort, the Engineer School will integrate the revisions into the resident officer basic and advanced courses. The new MQS materials are scheduled for their first appearance in officer classes in FY91.

The MQS I program provides tasks for precommisioning programs like West Point, ROTC, and OCS, and is entirely task oriented. This manual is undergoing final review at the Combined Arms Center.

The new MQS II program has two tiers: Tier I for lieutenants and Tier II for captains. The Combined Arms Center is currently reviewing the task summary sheets that will be included in the common guide, which is expected to be "on the street" by early next year.

The goals of the MQS II are to prepare company grade officers for their wartime missions, and to provide a sound basis for their continued professional development.

The revised MQS system is an officer professional development milestone. It will do much to guide officer training in critical engineer skills.

Questions or comments involving the development of the MQS system can be addressed to: Commandant, U.S. Army Engineer School, ATTN: ATSE-TDU-I, Fort Leonard Wood, MO, 65473, or call Autovon 676-7553/Commercial (314) 563-7553.

Captain Williams, currently in graduate school, was an analyst in the Directorate of Training and Doctrine (DOTD), at the Engineer School. He previously served as a company commander with the 35th Engineer Battalion. He is a graduate of the Combined Arms and Services Staff School. He holds a master's degree from Webster University.

Captain Young, commander of the International Student Detachment at Fort Leonard Wood, formerly worked in the Course Development Division, DOTD, at the Engineer School. He previously served as a company executive officer and platoon leader with the 10th Engineer Battalion. He is a graduate of the U.S. Military Academy.

Engineer Solution

Step 1. Determine the number of antitank (AT) mines required. Multiply the desired density by the minefield frontage:

0.75 mine per meter x 500 m = 375 mines.

Step 2. Determine the number of AT mines per row. Divide the minefield frontage by the desired spacing interval between mines.

Note: Round down the answer to the nearest whole number.

500 m ÷ 6 m = 83.3 (round down) = 83 mines per row.

Step 3. Determine the number of rows. Divide the number of AT mines by the number of mines per row.

Note: Round up the answer to the nearest whole number.

375 ÷ 83 = 4.51 (round up) = 5 rows.

Step 4. Determine the actual number of mines. Multiply the number of AT mines per row by the number of rows.

83 x 5 = 415 mines.

Step 5. Determine the number of AT mines to request. Allow for 10 percent waste. Multiply the actual number of AT mines by the 10 percent factor for waste.

Note: Round up the answer to the nearest whole number.

415 x 1.10 = 456.5 (round up) = 457 mines.

Step 6. Determine the number of trucks required. Refer to table B-1, page 249 in FM 20-32 or page 3-26 in FM 5-34.

457 ÷ 204 = 2.24 (round up) = 3 trucks.

This problem was submitted by SSG John Chester, an instructor in the Mine Warfare Branch, Department of Military Engineering, U.S. Army Engineer School.

LESSONS LEARNED

By Captain Martin B. Dorey

The following Lessons Learned apply to equipment, mobility, and survivability issues. Derived from after action reports submitted by the National Training Center, they are in the engineer lessons learned data base. For more information, write to Commandant, U.S. Army Engineer School, Attn: ATSE-ES-AL, Fort Leonard Wood, MO 65473-6630. Or, call (314) 563-5321/5339, AV 676-5321/5339.

ISSUE: Structural and curb damage to the Armored Vehicle Launched Bridge (AVLB).

DISCUSSION: The class 60 AVLB has sustained structural and curb damage because the M60/M48/M88 and M1 family of vehicles are driven at excessive speeds.

RECOMMENDATION: The Tactical Army Command (TACOM) imposed the following restrictions in a "Safety of Use" message issued in June 1987, subject: Operational Crossing Restrictions for Class 60 Bridge, Armored Vehicle Launched (NSN 5420-00-522-9599). These restrictions apply to combat vehicles that exceed a 50-ton vehicle weight.

- Vehicle must be centered on bridge.
- Maximum crossing speed is 8 miles per hour (13 km/hr).
- No stopping, accelerating or gear shifting while on the bridge.

All subordinate units and operators of vehicles exceeding 50 tons must follow these restrictions.

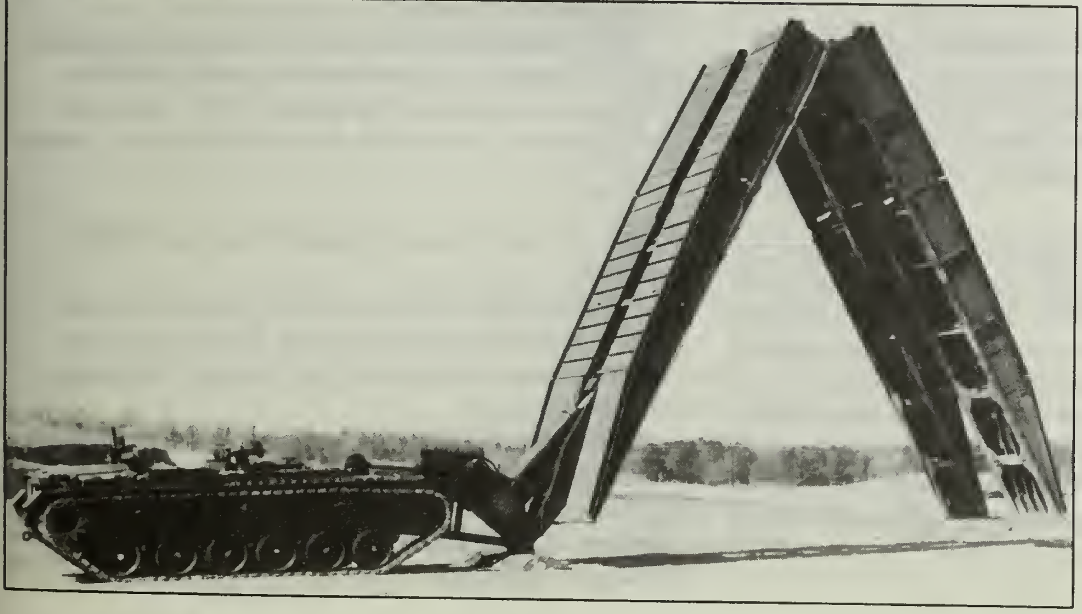
Units in charge of AVLB sites should fabricate conspicuous signs listing these restrictions and post them at crossing sites.

Commanders are responsible for ensuring that vehicle operators are properly briefed on crossing restrictions and for ensuring that operators strictly adhere to the restrictions.

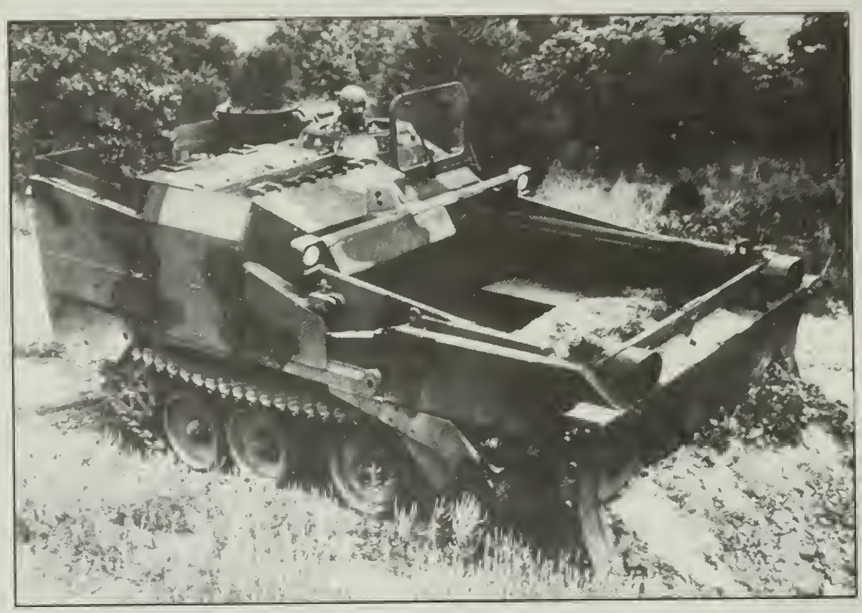
ISSUE: M9 Armored Combat Earthmover (ACE) Operations.

DISCUSSION: Testing of the ACE at Fort Hood, Texas, has produced the following lessons learned:

- *River Crossing.* The ACE should be used in tandem during river-crossing operations. One will prepare the access ramp; the other will prepare



Armored Vehicle Launched Bridge (AVLB)



M9 Armored Combat Earthmover (ACE)

for swimming and be available to recover the first, if required.

- *Slope Operations.* The ACE can negotiate slopes up to 60 percent and side slopes up to 40 percent. Excessive slope, heavy vegetation, and rocks can cause the ACE to throw a track. On very steep slopes, the vehicle climbs better in reverse.
- *Smoke Launcher.* The smoke grenade launcher system can provide a smoke screen approximately 125 meters away from the vehicle for a period of 30 seconds, depending on the weather. When the system is not being used, the rubber caps should be placed over the tubes to prevent rain, snow, or other foreign matter from entering them. The operator's hatch must be closed before firing to prevent accidental burning of the operator.
- *Vehicle Recovery.* Winch capacity of the ACE is 12.5 tons. Proper winding and lubrication procedures will ensure that this effective capacity is maintained. Deploy the ACE in tandem for recovery operations, especially in light divisions.
- *Night Operations.* Night-vision goggles are required when the ACE operates in the dark. Operators must receive acclimatization training for these goggles to avoid nausea while wearing them. Also, the instrument panel lights may cause the goggles to malfunction temporarily. Until a product improvement plan is completed to correct this situation, operators should turn off the panel lights when operating with night-vision goggles.

ISSUE: Lack of coordination and effective planning for breaching obstacles.

DISCUSSION: The task force engineer was not involved in the tactical planning phase for various missions. Therefore, the maneuver force was unable to coordinate breaching operations or use the engineer units effectively. As a result, breaching operations were ineffective and not according to doctrine. In one case, an obstacle that could have been bypassed easily was not. Due to lack of coordination, the engineers and maneuver units did not rehearse together. Instead, the individual company/teams and the engineers conducted separate rehearsals.

For one mission, the task force engineer was involved in planning and briefing the company/teams. This time the obstacles were breached effectively, which greatly improved the task force's ability to continue the attack.

RECOMMENDATION: Stress the effective use of task force engineers to maneuver commanders and the engineers themselves. Ensure the staff coordinates so that breaching is integrated into the tactical plan. Integrate the engineer and maneuver units and perform rehearsals to ensure successful obstacle breaching and continuation of the attack.

ISSUE: Cosmetic berms constructed in front of vehicle fighting positions provide no protection.

DISCUSSION: Engineers often expend much effort constructing berms in front of vehicle fighting positions. A berm creates a false sense of security for the user. A modern armor-piercing, fin-stabilized, discarding sabot (APFSD) round will easily penetrate loosely compacted soil berms.

RECOMMENDATION: Use the available engineer effort to construct additional survivability positions. Engineers must stress this lesson to the maneuver commander to ensure that these berms are no longer used.

ISSUE: Use of scoop loaders to dig survivability positions.

DISCUSSION: During a training exercise, a unit used a scoop loader to construct survivability positions. Because the soil was too compact, the equipment broke down.

RECOMMENDATION: Only responsible individuals knowledgeable of soil conditions should select the type of equipment to be used for digging survivability positions. Scoop loaders should be operated only in loose soil conditions.

ENGINEER UPDATE

Directorate of Training and Doctrine (DOTD)

Common Collective Task Training. Units without an ARTEP Mission Training Plan (MTP) are advised to use ARTEP 5-145-Series, as applicable, for common collective task training. The manual of common collective tasks and standards that was distributed in June 1989 for units without proponent MTPs is no longer available. It was developed primarily for use as a TRADOC training development aid, and had limited distribution on a one-time basis. Point of contact (POC) is Russ Hinkle, AV 676-7513, or (314) 563-7513.

Engineer Drills-ARTEP 5-14-DRILL. An ARTEP designed to support all combat engineer units is scheduled for publication in November 1990. ARTEP 5-145-Drill includes breaching, bridging, and CEV/AVLB drills. POC is CPT Frank Barry, AV 676-7512 or (314) 563-7512.

Units subscribing to ARTEP 5-025 and 5-145 series MTPs will receive ARTEP 5-145-DRILL on the initial distribution. Other units may order it from the U.S. Army Publications Distribution Center (USAPDC), 2800 Eastern Boulevard, Baltimore, MD 21220. Their hotline number is AV 584-2533 or (301) 682-8529.

Soldier Qualification Test (SQT) Notice. Soldiers are advised to study only those references given in the SQT notice by task. These references are used to develop questions in the individual SQTs.

Department of Combined Arms (DCA)

Attention Light Engineers. The 6th Annual Light Engineer Conference at Fort Leonard Wood, scheduled for 23-26 October 1990, has been cancelled. The conference will be rescheduled later, possibly for spring 1991. POC is CPT Thomas Kula, AV 676-5821 or (314) 563-5821.

Obstacle Control Problems. Combat Training Centers (CTC) report that obstacle control continues to be a major problem. Inadequate control procedures have led to fratricide and have hindered the mobility of friendly forces on the battlefield. Problems include improper reporting and recording, failure to disseminate obstacle location information to appropriate leaders and staff, inadequate obstacle turnover, failure to execute lane closure plans, and unmarked friendly minefields.

Obstacle control is a critical task that requires discipline and continual sustainment training. References are FM 5-100 for obstacle control, FM 5-102 for reserve obstacle procedures, and STANAG 2017 for target folder procedures.

Engineer and maneuver units rotating to a CTC must include obstacle control tasks when they conduct predeployment training. The following tips may help you improve these skills.

- Engineer platoon leaders and platoon sergeants must understand obstacle reporting and recording procedures and forward reports as required.
- Maneuver staffs must develop field/tactical standing operating procedures (SOP) that emphasize minefield marking requirements and standards.

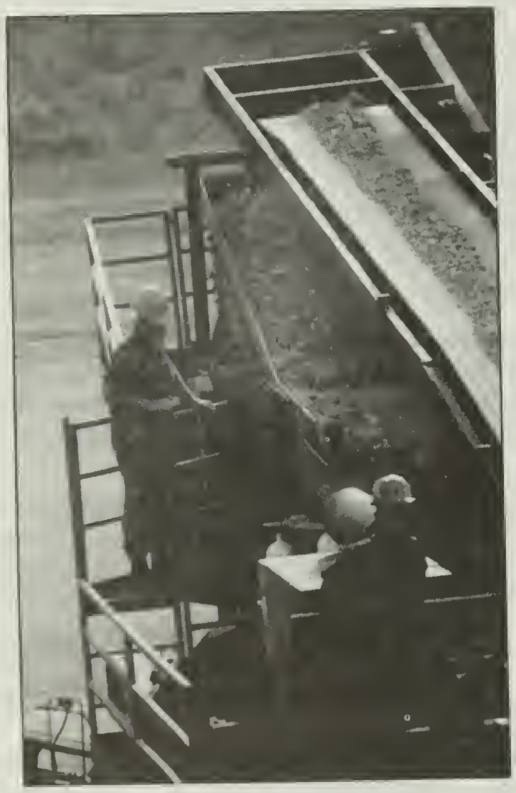
- Critical engineer-related items, such as reserve target responsibility or lane closure plans, must be stated in paragraph 3 of subunit instructions.
- Staff engineers must ensure that obstacle information is reported to the maneuver unit for dissemination.
- Staff engineers must emphasize to their maneuver commanders the need to rehearse lane closure plans.

POC is CPT Bob Wray, AV 676-5519, (314) 563-5519.

Directorate of Combat Developments (DCD)

New Rock Crusher On Board. Fort Leonard Wood and Fort Knox received new and improved rock crushing plants in August. The equipment can produce as much as 150 tons per hour (TPH), is mobile, diesel and electric motor driven, and has crushing and screening capabilities.

The rock crushing plants consist of several state-of-the-art components. The primary crusher consists of a Thunderbird trailer, John Deere diesel engine, Pioneer variable speed vibrating feeder, and a 3042 jaw crusher. The secondary crusher consists of a Thunderbird trailer and triple deck shaker box, John Deere diesel engine, and an El-Jay 45-inch cone crusher. The 1st Engineer Brigade, Fort Leonard Wood, is responsible for training on this equipment (see item on page 49). For more information, contact MSG Michael Hammond, AV 676-7344 or (314) 563-7344.


Rock crusher

"Bunker Busting" Systems Update. Three new weapons systems are being considered by the Engineer School as possible standoff bunker busters for the light engineer force. These systems are capable, in various degrees, of standoff bunker and field fortification reduction. Currently engineers are forced to use the 90mm recoilless rifle for this purpose. The introduction of one of these systems will allow the 90mm to be used solely for its intended purpose—killing tanks.

The three systems are:

- Ranger antiarmor/antipersonnel weapons system (M3 RAAWS). This system is now employed in NATO forces and will be issued to Army Rangers starting in September 1990.
- Multipurpose individual munitions (MPIM). This developmenta item is being evaluated by the Infantry School.
- Shoulder-launched multipurpose assault weapons (SMAW). This weapon was developed by the Marine Corps, and they are currently upgrading and modifying it.

A decision as to which, if any, of these systems will be issued t engineer forces is pending. POC is Benny Pardue, AV 676-7239 o (314) 563-7239.

Engineer Organization Changes. The engineer force structur concept for AirLand Battle-Future goes before the October 199 Common TOE Update board for final document validation an verification. The following engineer force structure changes are expected to occur out of this process:

- The heavy division engineer organization will consist of an engineer regimental headquarters, and three engineer battalion These are organized for 80 percent offensive support ar

20 percent countermobility support. All bridging assets will be located in the corps engineer brigade.

- The corps engineer brigade will include corps mechanized engineer battalions, and corps wheel engineer battalions. The reorganized combat support equipment company will include three similar earthmoving platoons. Other units within the corps engineer brigade structure include ribbon bridge companies, medium girder bridge companies, and a topographic company (all L-series TOE).
- At echelons above corps, the combat heavy engineer battalion will be reorganized similar to the Air Force's "Prime Beef" battalion. These battalions will support BASOPS and conduct nation assistance missions. POC is MAJ Joseph Seerley, AV 676-7149 or (314) 563-7149.

Department of Military Engineering (DME)

EOAC Division Update. Some Reserve Component officers continue to enroll in the incorrect resident phases. The Company Commander Course, Phase I - EOAC-RC, is Course 4-5-C23, not Course 4-5-C26, Phase I. Detailed course requirements are in the Army Formal School Catalog, DA Pam 351-4. A secret clearance is required for portions of the Company Commanders Course. Ensure that unit security managers have provided the necessary documentation before you arrive. POC is Captain Chuck Boaz, AV 676-5646 or (314) 563-5646.

Attention Vehicle Operators! Operators should *not* raise the hoods of vehicles when they park them in tactical bivouac areas. Hot engines will leave a significant thermal signature that may be detected by enemy infrared equipment. For more information, refer to Chapter 2 of FM 20-3. POC is CPT Vince Harackiewicz, AV 676-5585, (314) 563-5585.

Directorate of Engineer Branch Safety (DEBS)

M180 Firing Distances. The minimum safe distance when firing the M180 cratering kit is 1200 meters for unprotected personnel and 150 meters for personnel in missile-proof shelters. This information is in TM 9-1375-213-12-1, *Practice Mines Update*. Authorized practice mine and fuze combinations are in TM 43-0001-36, *Army Ammunition Data Sheets for Land Mines*. Use of any mine and fuse combinations other than those listed can result in serious injuries. POC is Paul Rusinko, AV 676-5002 or (314) 563-5002.

1st Brigade

Rock Crusher Training Implemented. Our latest acquisition, a rock crushing plant capable of producing as much as 150 TPH, was delivered in August. (See item under DCD, page 48.) The equipment is a significant addition to the quarry specialist training course (62G). Beginning in September 1990, all 62G students will receive training on the new crusher as well as the 75 TPH plant currently being taught. In addition, Reserve and National Guard soldiers who currently hold the 62G MOS will be sent to Fort Leonard Wood to train on this equipment. To accommodate the new training requirements, an additional 36 hours of technical training will be incorporated into the 62G Program of Instruction:

Current 75-Ton Per Hour (TPH) Crusher Course

Phase	*Hours*
Combat Engineer Training	43
MOS Specific Training	
Introduction	12
Assembly	16
Crushing (75 TPH)	36
Drilling	36
Demolition	24
Operation and Maintenance	20
Field Training Exercise	60
	247

Training for 150 TPH Crusher

Class	*Hours*
Operator Maintenance	8
Cone Adjustment	1
Jaw Adjustment	1
Replace/Adjust Bolts	2
Screen Adjustments	8
Crushing	16
	36

Students receive training on rock drills, scoop loaders, water pumps, conveyors, wash and screen units, demolitions, and maintenance. POC is MAJ Andrew Semple, AV 581-2519 or (314) 596-2519.

132 Brigade

Brigade Inactivated. When the 132 Brigade was inactivated in August, the 31st, 35th, and 589th Engineer Battalions became part of the 1st Engineer Brigade. The reorganized 1st Engineer Brigade is now responsible for MOS 12B/C Initial Entry Training, 15 Advanced Individual Training (AIT), one additional skill identifier (ASI) course, and Sapper Leader Training. POC is CPT Mark Lane, AV 581-4104 or (314) 596-4104.

136th Engineer Brigade

Quarry Detachment Welcomed. Fort Leonard Wood welcomed the 285th Engineer Quarry Detachment as the newest Forces Command (FORSCOM) unit on 17 October 1990. The 285th Enginee Detachment is relocating from Panama and will be assigned to the 515th Engineer Company (Pipeline) (Construction Support). The primary mission of the 31-soldier detachment is rock crushing operations. Capable of producing as much as 75 tons of crushed rock pe hour, the unit greatly improves the brigade's ability to accomplis major horizontal construction projects such as roads, storage facilities and airfields. POC is SFC Harkins, AV 581-7447.

News and Notes

Engineer Desert Operations. Engineer lessons learned applicable t desert operations are available in a report just published by the Enginee Studies Center, Fort Belvoir, Virginia. The book has nine sections cove ing everything from host nation support to well drilling and vehicle mai tenance. POC is Danny Brannon, AV 345-2115 or (703) 355-2115.

Training in World War II:

The 51st Engineer Combat Battalion

> *"In no other profession are the penalties for employing untrained personnel so appalling as in the military."*
> *General Douglas MacArthur*

PFC Elder D. Cannon, Company A, 51st ECB, on a "Watch on the Rhine" in March 1945. The success of the training the 51st received in New York and England was reflected in their many achievements during World War II (U.S. Army photo).

During World War II, the American Army called together millions of civilians and molded them into units that could work together to go about the business of winning the war. One such unit was the 51st Engineer Combat Battalion (ECB). How well it trained and the successful results of that training is the thrust of this article.

At the beginning of World War II, the United States Army sent its newly inducted recruits to units for training. Engineer Military Training Program (MTP) 5-1 called for 13 weeks of basic, individual, and team training. The next phase, unit and combined training, consisted of seven to eight months of training as a unit. It was followed by training with other units, and culminated in maneuvers with divisions, corps, and armies.

One of the 131 engineer units formed in 1942 was the 51st Engineer Combat Regiment (ECR), activated at Camp Bowie, Texas. In June of that year, the 51st Engineer Regiment's cadre of 76 enlisted men and 50 officers, most of them graduates of the Engineer Officer Candidate School at Fort Belvoir, Virginia, began cadre training. The Army training system depended on unit cadres who first received training and then trained new recruits.

A new commander, Colonel H. Wallis Anderson, took over the unit on August 17. Through example Colonel Anderson, a World War I veteran, laid the foundation for the development of teamwork and esprit de corps that bound the 51st together.

The unit moved to Plattsburg Barracks, New York, located about 20 miles south of the Canadian border on Lake Champlain, in October. The 51st chose Macomb Reservation, some 12 miles north of Plattsburg Barracks, as its field training area. There it constructed training sites in preparation for the arrival of basic trainees.

Enlisted men began arriving at the Plattsburg railroad depot on Christmas Day, 1942. The Army had inducted these men into the service from all corners of the United States, issued them

By Barry W. Fowle

Traffic rolls over a heavy pontoon bridge built over the Rhine River at Kripp, Germany, in 1945. This was one of many bridges built by the 51st Engineer Combat Battalion during their march across Europe (U.S. Army photo).

uniforms, and sent them to Plattsburg for training. By January 11 the strength of the regiment had increased from about 150 officers and men to more than 1,600. These recruits received a shock when they stepped off the train into 8 inches of snow and below-zero temperatures.

Training Begins

Basic, individual, and team training began in January and lasted until April. The recruits learned close order drill and then trained on crew-served weapons. During engineer training the men learned how to use explosives and demolitions, how to build field fortifications, how to emplace fixed and floating bridges, and how to build and repair roads and airfields.

Temperatures reached 35 degrees below zero on several occasions during basic training, and in most places the ground was covered with 2 feet of snow. Because Lake Champlain was frozen over, floating bridge training was conducted on ice that was 3-feet thick.

In spite of these conditions, the regiment conducted training outside. The 51st established an obstacle course to strengthen the stamina and self-confidence of each soldier. Many of the men came down with colds soon after arriving in Plattsburg, but the health of the unit returned rapidly after extensive physical conditioning. At the end of basic training each company built two tactical bridges at night under blackout conditions. This realistic training would pay dividends in the future.

In March 1943, the 51st Engineer Combat Regiment was redesignated. Its Headquarters and Service (H&S) Company became the 1111th Engineer Combat Group (ECG), its 1st Battalion became the 51st ECB, and the 2nd Battalion became the 238th ECB.

On April 7, the 51st ECB began unit and combined training at Macomb Reservation. The men marched 12 miles to Macomb on Monday mornings, where they practiced building various types of fixed and floating bridges. Then they marched back to camp on Friday afternoons. Everyone slept on the ground in pup tents during the week.

Near the end of April, XIII Corps conducted MTP tests for the 1111th ECG and its assigned units. The 51st ECB scored 83 percent, the highest rating of any similar organization in the XIII Corps.

Advanced training, which followed, included both infantry tactics and engineer training. It continued until September, when the battalion moved to the XIII Corps maneuver area in Davis, West Virginia. There the soldiers built roads and culverts, an airplane landing strip, and constructed a Bailey bridge and a fixed-target and known-distance range. The 51st moved to Fort Belvoir for 12 days as demonstration troops for the school, and then went to Fort Dix, New Jersey, to prepare for departure overseas.

After arriving in England on January 20, 1944, the 51st received more training. This included construction of Bailey bridges, mine and booby trap training (using the latest German mines and methods), camouflage training, and infantry tactics.

Combat Support

The men in the 51st bega using the training gaine over the past 18 months whe they landed in France on Jun

27, 1944. Their highly successful battalion operations in Europe demonstrated the quality of that training.

From June until November, while under First Army, the battalion moved across France constructing roads, bridges, and culverts, and sweeping areas for mines. In France and Belgium they replaced portable Bailey bridges with semi-permanent wooden bridges on major roads. The Bailey bridges were then moved forward for use in combat operations.

At the end of October, the 51st moved into Marche, Belgium, and began sawmill operations using local sawmills and their personnel. First Army tasked the 51st to produce three million board feet of lumber for its winterization program. The men of the 51st, who were trained in using chain saws, cut the trees for, and supervised the operation of, 32 sawmills. At peak production the three companies produced a total of 80,000 board feet of lumber each day.

Sawmill operations stopped on 17 December, when the 1111th ECG was assigned the battalion barrier operations along a 40-mile front against the German Army's Ardennes Offensive—the Battle of the Bulge. That evening Company C, 51st ECB, went to Trois Ponts to organize a defense of the town and prepare bridges for destruction. For three days the company held off German tank and infantry attacks until it was relieved by the 505th Parachute Infantry Regiment, 82d Airborne Division. The infantry training the unit received in Plattsburg served them well.

River Crossings

The rest of the battalion was assigned the mission of preparing all crossings of the Ourthe River from Durbuy to La Roche, France, for demolition. They were also tasked to establish obstacles such as minefields and abatis on roads near the river. The battalion's key point in that defensive line was the Ourthe River bridge at Hotton. On December 20, Company B and the First Platoon, Company A, held off a German tank and infantry attack at that bridge for 7 hours.

Tiny elements of all three line companies and the H&S Company manned roadblocks scattered throughout the area and stopped the Germans cold. For its actions in the Battle of the Bulge, the 51st ECB received the Distinguished Unit Citation and the French Croix de Guerre.

During the first two months of 1945, the 51st supported both the 82d Airborne Division and the 75th Infantry Division, building bridges, maintaining roads, and removing numerous minefields and barriers. In January, the battalion constructed five Bailey bridges in four days. One was constructed at night, while under enemy fire and in terrible weather. Three days of rain, snow, and freezing temperatures had coated the bridge parts with a layer of ice. Blow torches used to melt the ice brought in enemy artillery fire, forcing the men to use hacksaw blades to cut the ice away. The winter training received at Plattsburg again proved to be useful.

On March 7, the Americans captured the famous Ludendorff Bridge over the Rhine River at Remagen. III Corps chose the 51st and 291st ECBs to build two bridges over the Rhine so that American troops could cross while the heavily damaged Ludendorff bridge was closed for repairs. The 51st built a 969-foot heavy ponton bridge at Kripp, about 1.5 miles south of Remagen, while under small arms and artillery fire and German fighter attacks. It was completed on March 11, 27 hours after construction started.

When the bridges were finished, Major General John Millikin, commander of III Corps, praised the two engineer battalions. "I feel that one of the most outstanding accomplishments of the entire operation was the building of the two additional bridges under artillery and small arms fire."

The 51st was assigned to General George S. Patton's Third Army on April 17. Two days later the battalion began and completed a 255-mile trip in 20 hours with just one major breakdown, which was quickly repaired. The success of the road march reflected the high state of maintenance of the equipment in the 51st and was a credit to its training.

Mission Completed

Company A, 51st ECB, began a 325-foot class 40 treadway bridge over the Danube River at Ingolstadt on April 26. They were under direct German fire from the far side of the river during construction. The 51st crossed the Danube and finished the war maintaining roads, filling craters, and building Bailey bridges.

On May 12, Lieutenant Colonel Harvey R. Fraser, the battalion commander, called the men together and addressed them as a group for the first time since he joined the unit in mid-December. He paid tribute to the 51st for the work the men had accomplished during their drive across Europe.

Well might he have given them praise. The unit had performed in an outstanding manner while accomplishing all of its missions, both as engineers and as infantry. That it did so can be traced to the high caliber of training the unit received in the rugged, cold weather at Plattsburg, New York, and in England.

(This article is based on a history of the 51st, *The 51st Again,* scheduled for publication in 1991.)

Barry W. Fowle is a historian, Office of History, Headquarters, U.S. Army Corps of Engineers.

DEPARTMENT OF THE ARMY
ENGINEER PROFESSIONAL BULLETIN
US ARMY ENGINEER SCHOOL
ATTN: ATSE-TDM-PB
FORT LEONARD WOOD, MO 65473-6650

USPS 522-390
OFFICIAL BUSINESS

SECOND-CLASS MAIL
POSTAGE AND FEES PAID
DEPARTMENT OF THE ARM
ISSN 0046-1989

The Engineer Button

PIN: 045-03

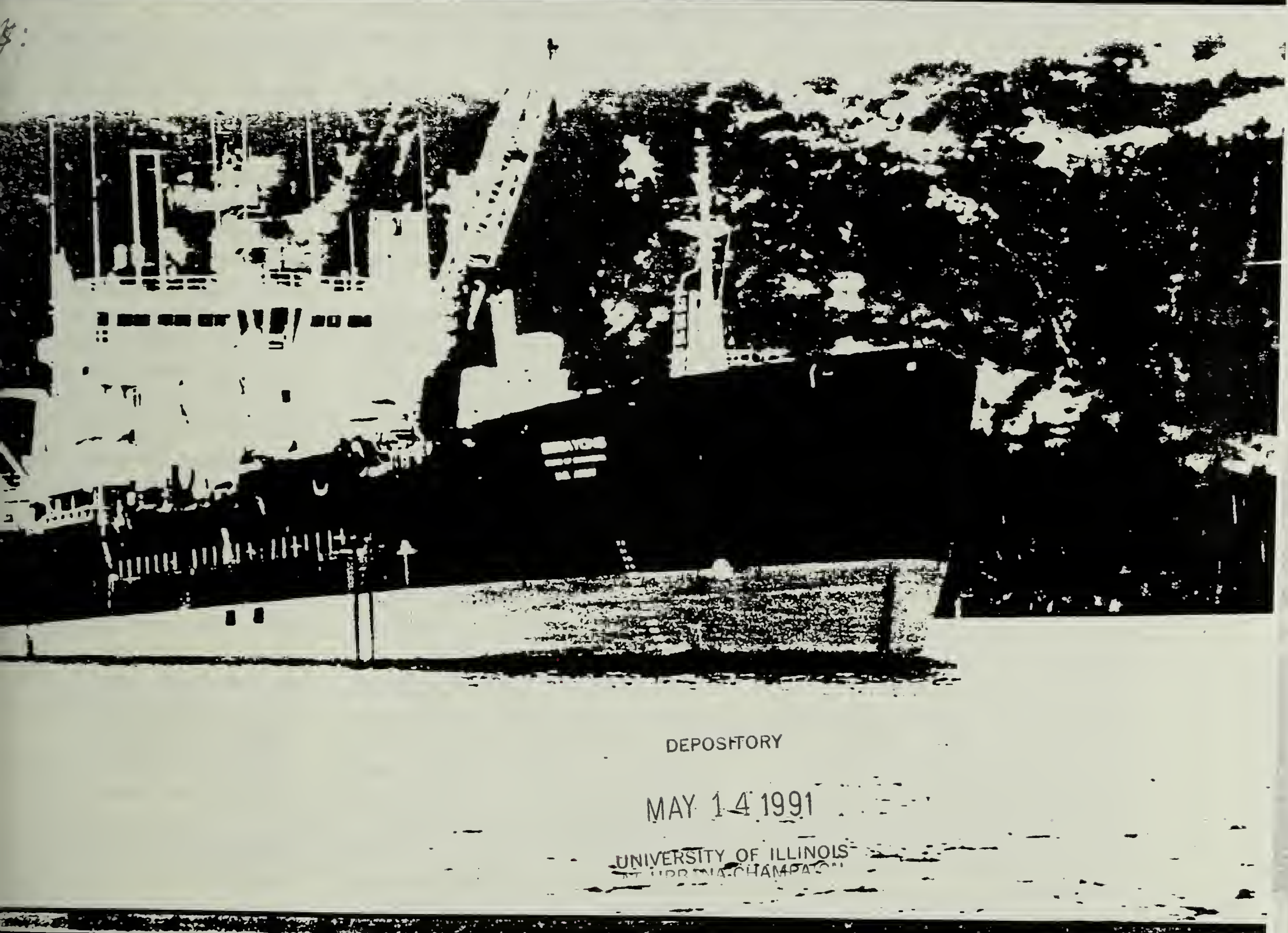
3. 205

JUN 03 1991
ENGINEERING

ngineer

E PROFESSIONAL BULLETIN FOR ARMY ENGINEERS
dquarters, Department of the Army

January 1991



DEPOSITORY
MAY 14 1991
UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

Civil Works and Military Construction

PB 5-91-1

Approved for public release; distribution is unlimited.

Personal Viewpoint

Teamwork: The Key to Success

The history of United States military operations is replete with examples and situations where Army and Marine Corps units have stood shoulder to shoulder on the same battlefield. From Mexico City in 1847 to the Argonne Forest in World War I; from Saipan and Okinawa in World War II through Korea and Vietnam; as recently as Grenada and Panama; and, of course, today in the desert of Saudi Arabia, soldiers and Marines have been part of the same force. All indications are that this trend toward joint operations will increase as we move into the 21st century.

While tomorrow's battle plans are being developed to address all phases of low-, mid- and high-intensity conflicts, there is no doubt that the support provided by combat engineers will always be a critical requirement. The Army's AirLand Battle doctrine and the Marine Corps' philosophy of maneuver warfare both call for engineers to increase the combat effectiveness of the total force.

Marine engineers are found in combat engineer battalions of Marine divisions, engineer support battalions of force service support groups, and Marine wing support squadrons of the aircraft wings. Combat engineer battalions provide direct combat engineer support to infantry regiments in the forward portion of the battle area. Engineer support battalions provide general engineering support to landing forces, and they reinforce combat engineer battalions when necessary. Engineers in Marine wing support squadrons provide ground engineer support to the Marine aircraft wings. All engineer forces are manned, equipped, and trained to deploy rapidly and provide support to the Marine air-ground task forces.

With today's projected force reductions and the continuing competition for limited resources, I believe the development and continued evolution of Army and Marine engineer forces should be closely coordinated in three specific areas.

Doctrine. Staffing of doctrine for mobility/countermobility, demolitions, survivability, bridging, vertical and horizontal construction, and all other aspects of combat engineering should be shared between our separate headquarters. I include in this joint review process the preparation and revision of Army field manuals (FM), Marine Fleet Marine Force Manuals (FMFM), and technical manuals (TM).

Solicitation of comments and inclusion of pertinent information from both services will lead to the production of more complete and sound documents than those currently available. After such closely coordinated publications are distributed, their use will be more widespread and content revisions should be required on a less frequent basis.

Equipment. Development and procurement of common engineer equipment should remain as one of our goals. The armored combat earthmover (ACE), small emplacement excavator (SEE), and mine clearing line charge (MICLIC) are but a few recent examples of items which can b
employed successfully by all con
bat engineers. Who knows wh
the future may hold in this area

Obviously the missions, role
and concepts of employment di
tate that not all equipment
suitable for use by both service
The Marine Corps' amphibio
and expeditionary role calls f
equipment that can be broug
across beaches, that is helicopt
transportable, and that can trav
with the maneuver force at hi
speed. In many instances, toda
Army has the same requiremen
Thus, cooperative efforts in
search, development, and procu
ment will lead to more efficie
use of time and resources.

Training. The joint training
Army and Marine engineers at f
mal schools should continue wh
ever possible. Also, the preparat
and validation of engineer ba
drills should be a compilation
input from both services. Fina
major joint training exercises p
vide invaluable opportunities,
these should be scheduled as
quently as practicable.

Currently, more than 50
listed Marines attend schoolin
Fort Leonard Wood each ye
These Marines receive trainin
drafting, surveying, and mate
quality specialist courses. A
tionally, 10 Marine captains
tend the Army's Engineer Off
Advanced Course each ye
Cross training of soldiers
Marines takes advantage of
ready existing facilities, curric
and faculties. Cross training
also lead to more innovative
open-minded thinking

(Continued on page 28)

By Lieutenant Colonel John E. Drury, USMC

Engineer

January 1991

Volume 21 PB 5-91-1

UNITED STATES ARMY ENGINEER CENTER AND FORT LEONARD WOOD

COMMANDER/COMMANDANT
Major General Daniel R. Schroeder

MANAGING EDITOR
Catherine Eubanks

FEATURES EDITOR
Phillip R. Howell, Jr.

GRAPHIC DESIGNER
Jennifer C. Bolyard

By Order of the Secretary of the Army:

CARL E. VUONO
General, United States Army
Chief of Staff

Official:

JOHN A. FULMER
Colonel, United States Army
Acting The Adjutant General

Cover photo: The Army hopper dredge Essayons during Valdez oil recovery operations.

FEATURES

4 Engineer Hopper Dredges & The Valdez Oil Recovery Operation
by Captain Charles Heaton, Jr.

10 Dust Control In Saudi Arabia
by Major Michael F. Hullihan

13 Civil Works - Another Side Of The Army Engineers' Mission
by Major General Patrick J. Kelly

22 Some Of The Best Training Anywhere
by Captain William E. Rapp

25 District Project Engineer: The Road Less Travelled
by Major John Nelson and Captain Donald Curtis, Jr.

34 CADD Makes Its Mark
by Rick Seams and Ron Wenrich

36 Building To Last In The Tropics
by Captain Kevin S. Porter

39 MOBNET And Army Mobilization Planning
by Terry Atkinson

Editor's Note: Because of the author's deployment on Desert Shield, an article on obstacle integration scheduled for this issue will appear later in the year.

DEPARTMENTS

Inside Front Cover: **Personal Viewpoint**

2 Clear the Way
3 Bridge the Gap
18 Engineer Problem
21 Engineer Safety
29 Engineer Solution
44 Engineer Update
48 Past In Review

ENGINEER (ISSN 0046-19890) is prepared quarterly by the U.S. Army Engineer School, ATTN: ATSE-TDM-PB, Fort Leonard Wood, MO 65473-6650. Second Class postage is paid at Fort Leonard Wood, MO, and additional mailing offices.

POSTMASTER: Send address changes to ENGINEER, the Professional Bulletin for Army Engineers, ATTN: ATSE-TDM-PB, Fort Leonard Wood, MO 65473-6650.

CORRESPONDENCE, letters to the editor, manuscripts, photographs, official unit requests to receive copies, and unit address changes should be sent to ENGINEER, at the preceding address. Telephone: (314) 563-7762, AV 676-7762.

DISCLAIMER: ENGINEER presents professional information designed to keep Army engineers informed of current and emerging developments within their areas of expertise. Views expressed are those of the author and do not necessarily reflect official Army or TRADOC positions, nor does the content change or supersede information in other official Army publications. ENGINEER reserves the right to edit material.

CONTENT is not copyrighted. Material may be reprinted if credit is given to ENGINEER and the author.

OFFICIAL DISTRIBUTION is targeted to all engineer and engineer-related units.

PERSONAL SUBSCRIPTIONS are available by contacting the Superintendent of Documents, ATTN: Chief, Mail List Branch, Stop SSOM, Washington, DC 20402. Address changes for personal subscriptions should also be sent to the Superintendent of Documents.

CLEAR THE WAY

By Major General Daniel R. Schroeder,
Commandant, U.S. Army Engineer School

Today, engineer soldiers face a multitude of challenges: deployments to Central and South America; humanitarian construction missions; readiness training at the National Training Center and the Joint Readiness Training Center; on-going civil works and environmental remediation; maintaining a forward presence in Europe, Central America, and Korea; and, of course, our current deployments in support of Desert Shield. You are doing all of these, and doing them well. Active Army, National Guard, Reserve and forces are meeting all of these challenges. Current successes, as with those of the past, are a testament to good training and leadership.

The most recent success involves our support of Desert Shield, and this is obviously our first priority at this time. To date, more than 6,000 engineer soldiers have deployed to Saudi Arabia. We have deployed the right combination of skilled soldiers and equipment in a timely manner to perform a specific mission: deter further Iraqi aggression. Picking up that many soldiers with their tons of equipment, placing them on the other side of the planet, and sustaining them is a remarkable feat in itself. That our soldiers have done this and are now in the execution phase of their mission shows how successful their leadership and training have been.

Fort Leonard Wood's 5th Engineer Battalion is among the many engineer units deployed for Desert Shield. While formally inspecting these proud soldiers at the farewell ceremony, I was struck by their professionalism and confidence. As with other deploying units across the nation, these soldiers were doing what they had trained to do, and without exception they were doing it well.

In speaking with many soldiers and their families, I was again impressed with the value of sound leadership and tough training. An important part of that leadership is taking care of families. Leaders at all levels must make the strong commitment to soldiers that their families will get the support they need. Every installation with alerted units will similarly support the family members of deployed soldiers.

While the current focus is on Southwest Asia, we cannot ignore the possibility of other regional conflicts. We must sustain our readiness to meet contingencies elsewhere in the world and prepare for additional deployments to Southwest Asia if they are needed. Europe, Central America, and Korea will co tinue to demand our attention.

Today's Army must and does provide our great na tion with unique strategic capabilities that are versatile in nature and global in scope. As in operations Urgent Fury, Just Cause, and now Desert Shield, en gineers must stand ready to be projected into any troubled part of the world. We must continue to hon our skills through deployments for training in Centra America, to the National Training Center and the Jo Readiness Training Center, or to any location that provides a training opportunity.

Exercise-related construction and humanitarian civic assistance provide ideal training opportunities. In addition to developing engineer skills, they provic opportunities to work with other services and nation At a time when joint and combined operations have become the norm, we must not underestimate the value of these experiences.

Army engineers must also maintain their readine for civil works, military construction, disaster prepar ness, and environmental remediation. The Exxon V dez oil spill, Hurricane Hugo, last year's earthquake in California, and fires in our national forests are ex amples of recent disasters where Army engineers were called upon to provide relief. The routine stewardship of our national resources and infrastru ture that is being done every day by our Engineer tricts provides a strategic and environmental found tion for our nation's future. Dredging harbors and maintaining the navigability of rivers are tasks that are vital to today's and tomorrow's economic strength. Works such as these are not simply an a junct to our warfighting mission, they are an integr part of our engineer contributions to the nation's strength and security.

Army engineers must be ready to meet every co tingency from high-intensity conflict to peaceful cor petition among nations. It is incumbent upon all of to be ready mentally, physically, and spiritually. Tra ing and leadership are common denominators in meeting this broad continuum of challenges. The t are inseparable; a good leader must also be a goo trainer. Soldiers at all levels of responsibility incur obligation to train and lead to the absolute best of their abilities. The nation and our fellow soldiers e pect that of us.

BRIDGE THE GAP

By Command Sergeant Major W. E. Woodall
U.S. Army Engineer School

Challenging and diverse duties are a fact of life for every non-commissioned officer (NCO). Because these duties are so numerous, some NCOs may feel there are stages during their careers when it is impossible for them to keep up with day-to-day missions and still have time to pursue self-development.

But this is not so. Self-development is key to any NCO's success. Being responsible for their self-development is one of the "three pillars" of becoming an effective leader, and it cannot be put on the back burner for long. NCOs must make time to improve themselves if they want to succeed in our modern, technical—and highly competitive—Army.

By the same token, our Army leadership is responsible for recognizing NCOs' self-development efforts, and they must provide the encouragement and support NCOs need to better themselves.

The new Self-Development Test (SDT) is one way in which NCOs will be able to better themselves in the future. Many questions and concerns have been raised about the SDT, which will soon replace the Skill Qualification Test (SQT). And, while much about the test is still in the proposal stage, I will give you as much information as we have now.

First, the facts. The objective of the SDT is to allow sergeants, staff sergeants, and sergeants first class to measure and guide their growth in the skills and proficiencies they need to develop as leaders. While most of the SDT will focus on job-related skills, it is not intended to be a military occupational specialty (MOS) test.

The SDT will be a formally administered, 2-hour test made up of 100 questions. Sixty of them will be MOS-related, and these will be taken from the Soldier's Manual. Twenty questions will deal with leadership. They will be developed by the Center for Leadership, based on FM 22-100, FM 22-101, and FM 22-102. The remaining 20 questions will relate to training; they will be developed by the Sergeants Major Academy from FM 25-101.

Separate tests will be developed for each skill evel, sergeant through sergeant first class. Each test will be reviewed by a panel of sergeants major and validated by a group of soldiers from that career field before testing begins.

Soldier's Manuals will continue to be issued 6 months prior to the test date. The leadership and raining manuals will be issued to soldiers when they ttend the Primary Leadership Development Course r at their units, and these will be considered the oldier's personal property.

SDT notices will be provided to soldiers 60 days prior to their test date. However, preparation for the test will be the individual's (not the unit's) responsibility. There will be no unit-level "cram sessions," and no preparation will be allowed during duty hours.

For FY 91, all soldiers will continue to take the SQT. The SDT testing for Active Component (AC) soldiers will begin in FY 92. Reserve Component (RC) soldiers will take the SQT in FY 92 and begin SDT testing in FY 93. The AC soldiers will take the SDT every year, RC soldiers will take it every two years.

The final fact about the new test is that SDT results will be linked to the Enlisted Personnel Management System. Test scores will be used when a soldier is being considered for retention, school selection, promotion, reclassification, or separation.

Still in the proposal stage is just how the SDT will be implemented and scored, and more importantly, how scores will be used to determine a soldier's career options. For example, one proposal under consideration is that a soldier must score 70 percent or higher on the SDT in order to be promoted or selected for school.

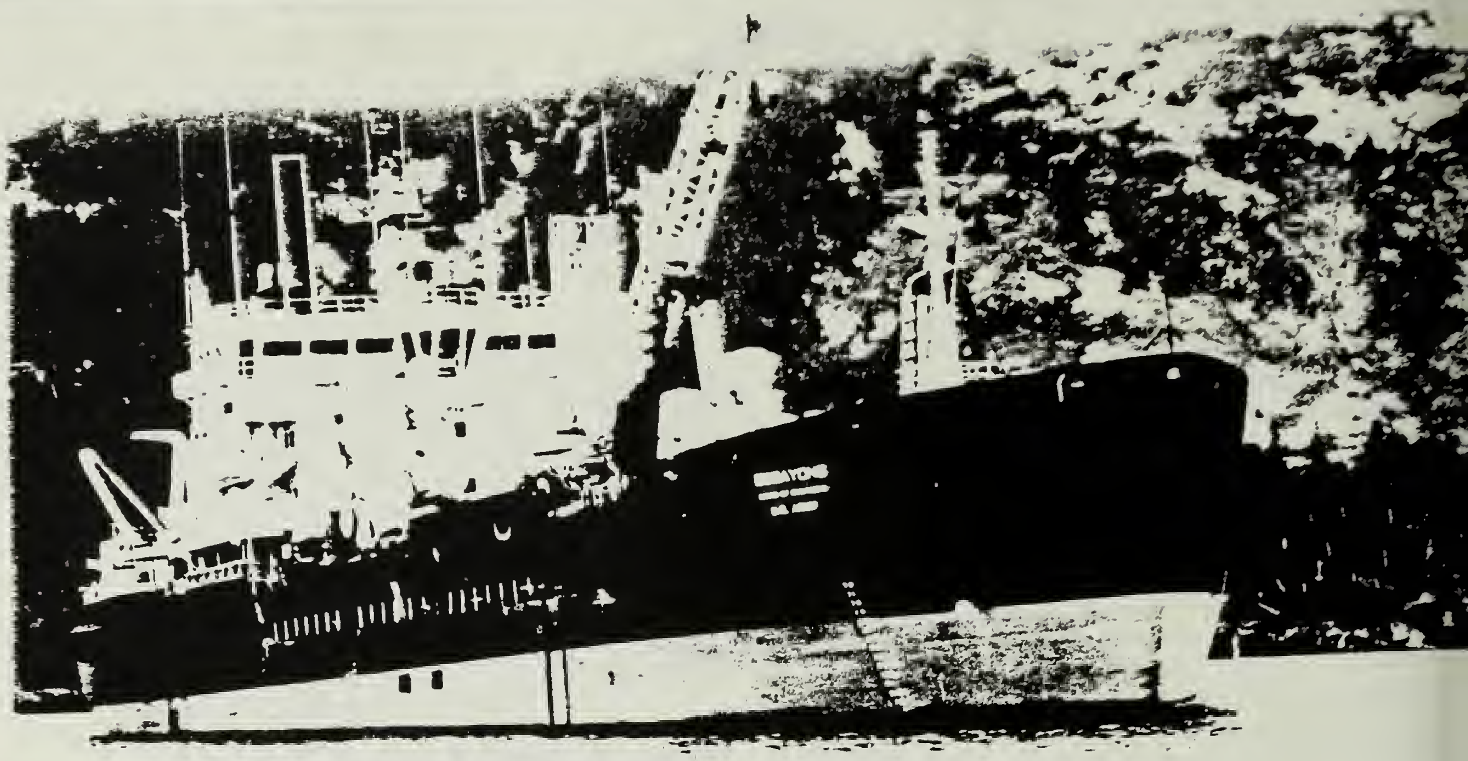
The test window for the SDT is not yet decided. The Department of the Army has proposed there be one test window for the entire Army, and a final decision on this proposal is expected in January 1991.

Another self-development arena—Common Task Testing (CTT)—will change in FY 92.

A new strategy has been developed for CTT. Beginning in FY 92, CTT will include skill levels two through four for sergeants through sergeants first class. This change is intended to make the CTT a progressive and sequential tool. It is based on recommendations by the NCO Leader Development Task Force and input from the Major Army Commands, and has been endorsed by the Army Chief of Staff. The option of providing alternative written tests for those who cannot participate in hands-on CTT due to lack of equipment or other limitations will be eliminated. The hands-on CTT will be a requirement.

These changes to our NCO training program will emphasize an increased responsibility on the individual NCO for his or her own development. However, it should not launch us into unfamiliar territory. As non-commissioned officers and leaders, we have always been responsible for developing our training and leadership skills.

Let's not wait until the SDT is upon us. Start an individual program of self-development today. You will progress into a more competent and confident leader of soldiers—of tomorrow's Army.



Engineer Hopper Dredge

& The Valdez Oil Recovery Operation

By Captain Charles Heaton, Jr.

On March 24, 1989, the tanker Exxon Valdez departed Valdez, Alaska, with a full load of crude oil for west coast refineries. Less than two hours after departure, the huge ship ran aground on Bligh Reef in eastern Prince William Sound. Approximately 11 million gallons of Alaskan crude gushed into the sound. The resulting oil slick spread west across Prince William Sound and out into the Gulf of Alaska. Patches of Valdez oil were eventually sighted in the Shelikof Strait, more than 300 miles from Bligh Reef.

On April 6, 1989, the Corps of Engineers, Alaska District, became an operational element of Joint Task Force Alaska, mobilized to help clean up the oil spill. Two Corps of Engineer hopper dredges, the Yaquina and the Essayons, were sent to assist in the effort. The Yaquina left her home port of Astoria, Oregon, on April 14, and arrived in Prince William Sound four days later. The Essayons
Astoria on April 17, and arriv
the spill area on April 21.

In this article, I will show
engineer ingenuity allowed
dard hopper dredges to be
effectively in oil recovery o
tions—despite the vessels
parent unsuitability for the
I've included background info
tion on the spill, general info
tion on hopper dredges,
methods of enhancing th
recovery capabilities of dredg

The Background

Alaskan crude oil is pumped from the North Slope oil field, the United States' largest oil reserve. After tapping these vast reserves, a way had to be found to get the oil from the Arctic Circle to coastal refineries.

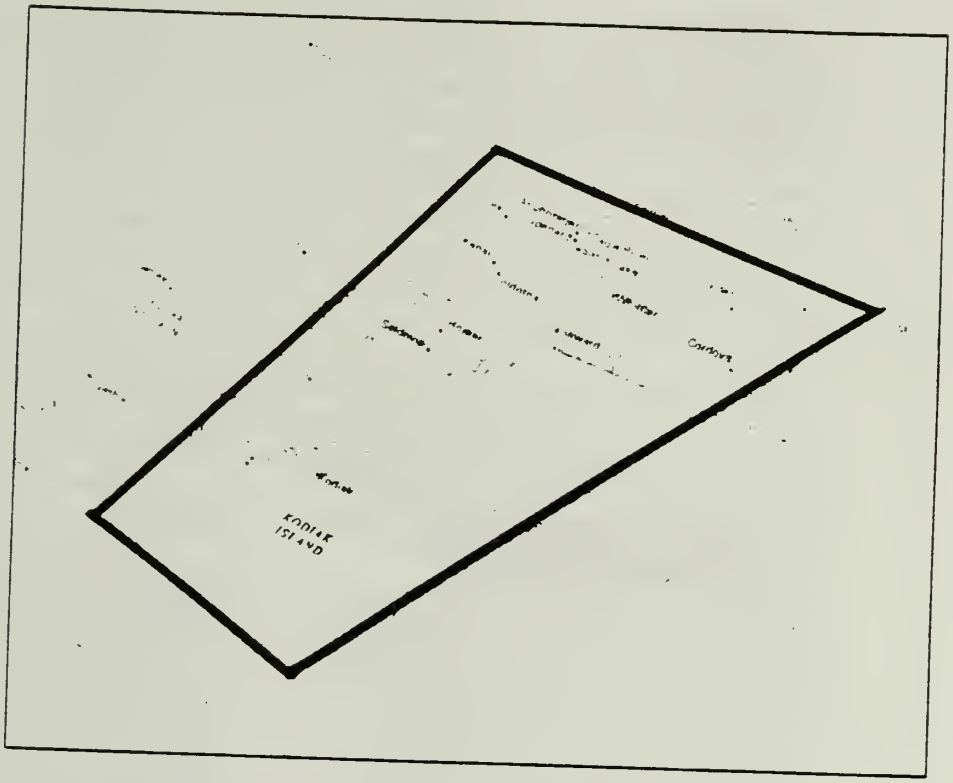
After much study, debate, and exhaustive environmental surveys, a pipeline was recommended. This pipeline linked the northern oil fields with Valdez, Alaska, and the year-round deep water port of Prince William Sound.

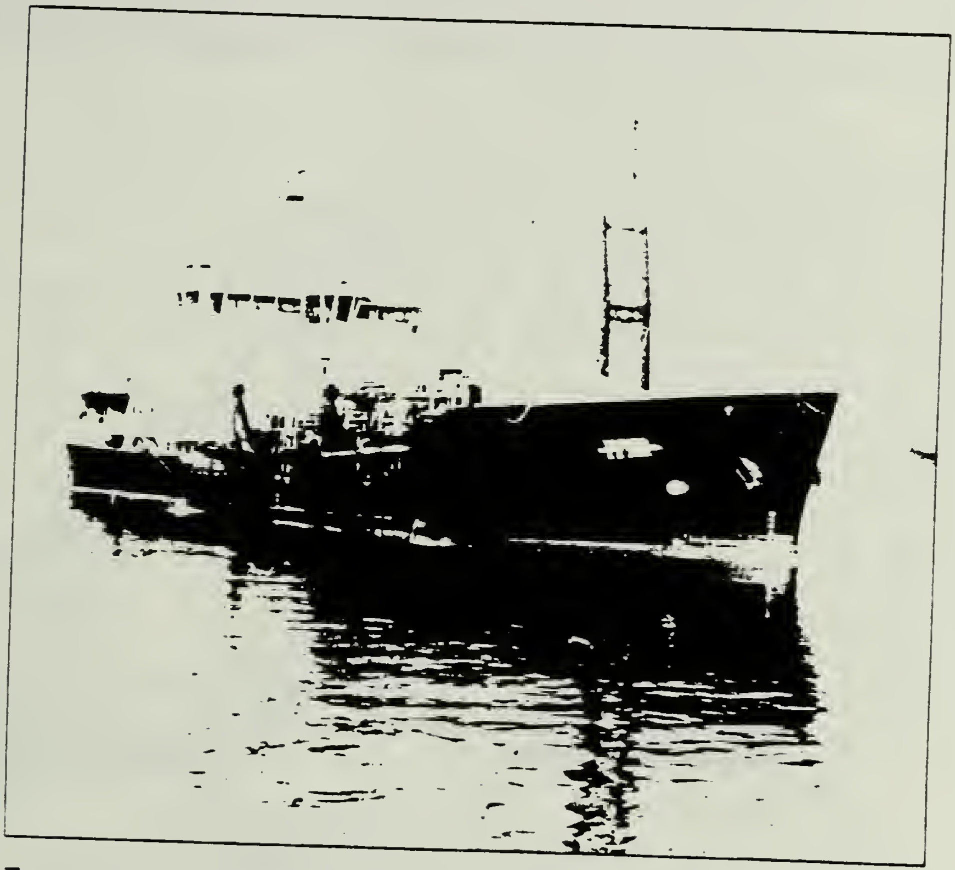
The $7.7 billion Trans-Alaska pipeline, owned jointly by eight major oil companies, is a 49-inch-diameter, 789-mile-long tube which carries about 1.5 million barrels a day. Within hours of reaching Valdez, Alaska, the oil is loaded into one of more than 60 ships that ferry their cargo to refineries or to other oil transportation points.

Since the pipeline opened in 1977, an estimated 6.8 billion barrels of oil have been transported without incident in more than 8,500 tanker voyages through Prince William Sound. But during the early hours of March 24, 1989, that commendable record came to an end.

The Exxon Valdez, which has since been renamed the Exxon Mediterranean, has a capacity of more than 1.4 million barrels of oil. The vessel was loaded with about 1.2 million barrels of oil when it left the Valdez dock at about 9 p.m. on March 23, bound for Long Beach, California.

The 987-foot ship was traveling at about 8 knots in the outbound channel when icebergs were detected on radar. The ship's captain requested and was granted permission to use the inbound ane in order to avoid the ice. However, the ship strayed nearly 3 miles beyond the eastern edge of he inbound lane.





Top: An estimated 700 miles of coastline were affected by the oil spill. By April 2, the oil had been blown southwest to Shelikof Strait and Kodiak Island—moving 300 miles in eight days.

Bottom: The hopper dredge Yaquina.

At 12:04 the next morning, the tanker ripped open its hull on Bligh Reef, pouring oil into Prince William Sound at a rate of nearly 1,000 gallons a second. Oil escaped from the ship with such force that it rose above the surface in three-foot waves. Within four days, the oil slick covered more than 100 square miles of Prince William Sound.

The Alaskan crude aboard oil tankers has a specific gravity of about 0.85, which means it's about 15 percent lighter than water. But when crude oil is spilled into salt water, many changes take place. About 24 hours after a spill, depending on weather conditions and wave action, the oil emulsifies with the sea water to form a very viscous material containing up to 70 percent water. The crew of the Army dredges found this material to have about the same viscosity as refrigerated chocolate syrup.

This material, called "chocolate mousse" by many of those who had to deal with it, had a serious impact on beaches and shorelines from Prince William Sound to Kodiak Island. It's been estimated that as many as 700 miles of coastline were affected by the oil spill. In some areas, the oily goop deposited by the tides was as much as six inches thick.

As the tides continued their cycle, the oil worked deeper into the coarse gravel and rock beaches. In some cases, the oil soaked through to a depth of four feet, effectively sterilizing the beaches.

By April 2, 1989, oil from the ship had been blown southwest to the mouth of Cook Inlet, causing extensive damage to the shorelines of Katmai National Park on Shelikof Strait across from Kodiak Island. When the oil reached this point, it had moved 300 miles in only eight days.

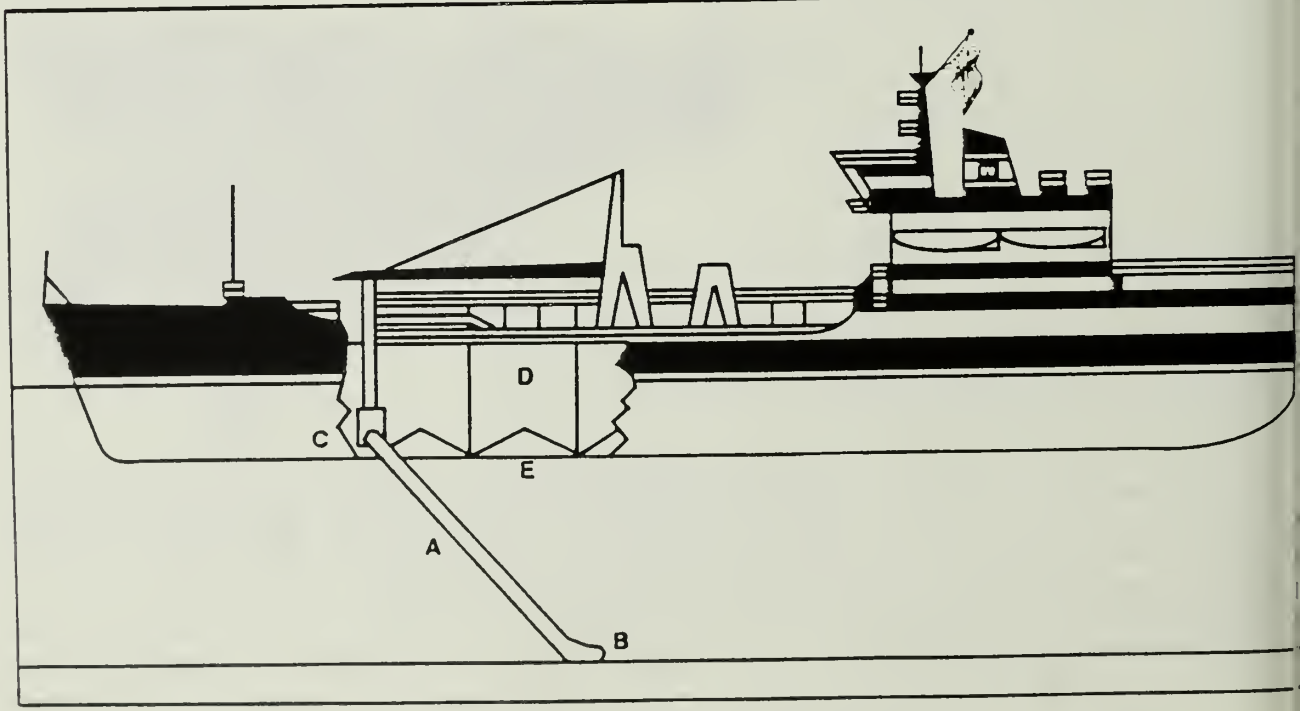
The Dredges

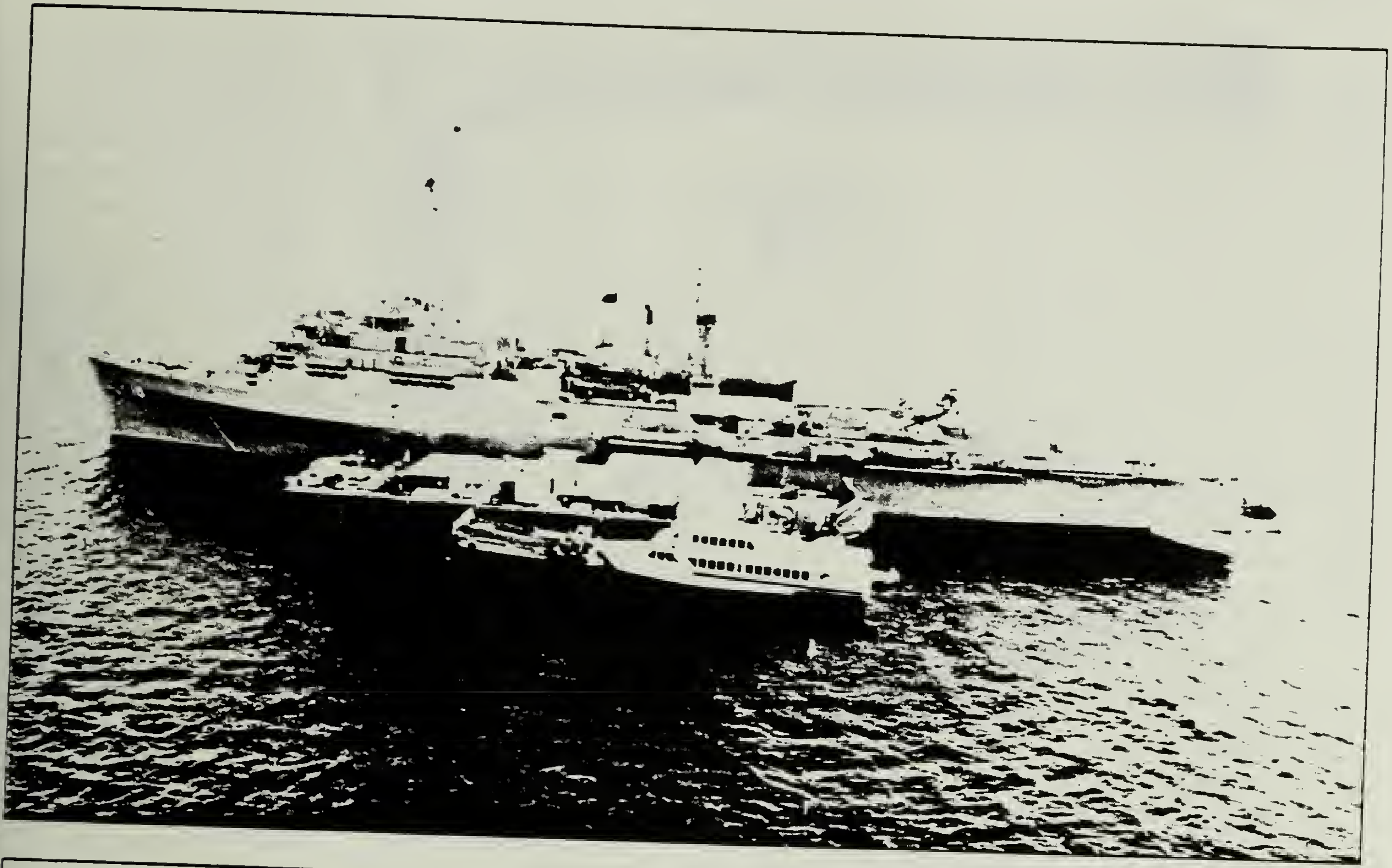
The Yaquina and the Essayons are hopper dredges, designed to dredge material from waterway bottoms, transport it to open water, and dump it. A simplified drawing of a typical hopper dredge below, shows a drag arm (a) with a drag head (b) extending from each side of the ship's hull.

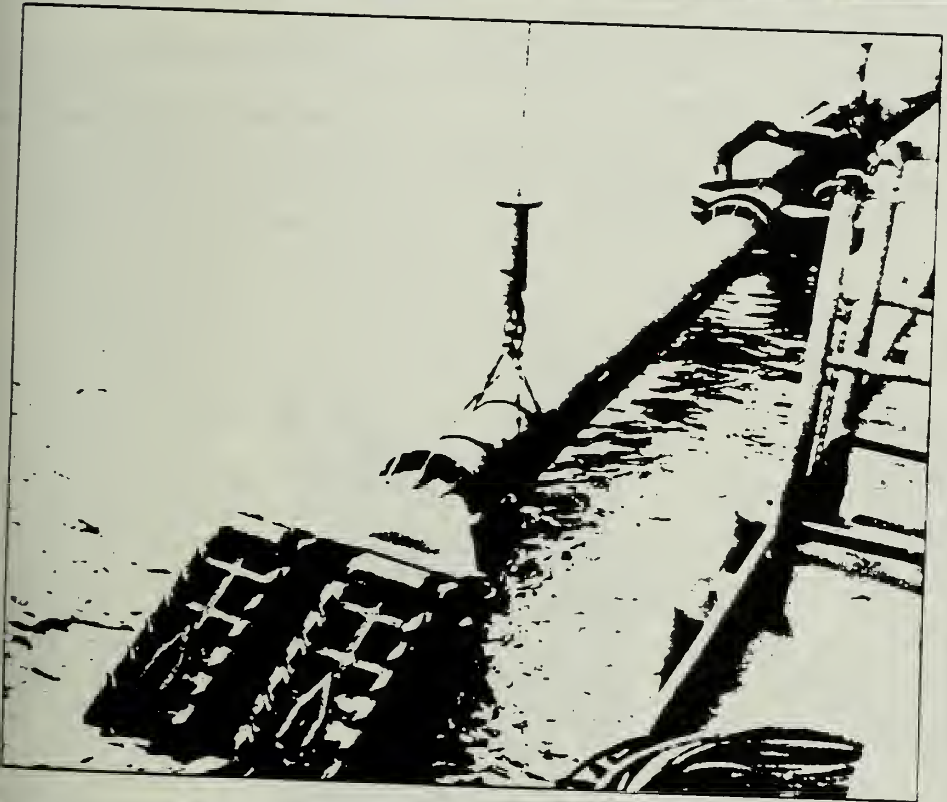
During dredging operations, the drag heads are lowered to the channel bottom and slowly pu
over the area being cleared. '
vessel's pumps (c) create suctio
the drag arms, and the silt or s
is drawn up through the d
arms to be deposited in the hop
bins (d). The solids settle out,
excess water escapes thro
weirs in the hoppers.

When the hoppers are full,
dredge sails to a disposal area
dumps the dredged materia
opening the hopper doors (e) in
bottom of the hull. The pump
the dredge are capable of mo
more than 15,000 gallons of w
and dredge material a minut
typical dredge can store more
6,000 cubic yards of dre
material.

The initial concern of gov
ment and corporate offic
directing the cleanup was
hopper dredges would not
productive asset for oil reco
Neither dredge was outfitte
oil recovery or had ever
ticipated in such operations.
dredges' first attempts a
recovery justified their con
Initial recovery efforts invo
lowering a dredge's drag arm
the surface of the water, and
"vacuuming" up the oil. T







Top: The Navy's U.S.S. Juneau anchors in Prince William Sound, where it quartered and controlled hundreds of clean up workers.

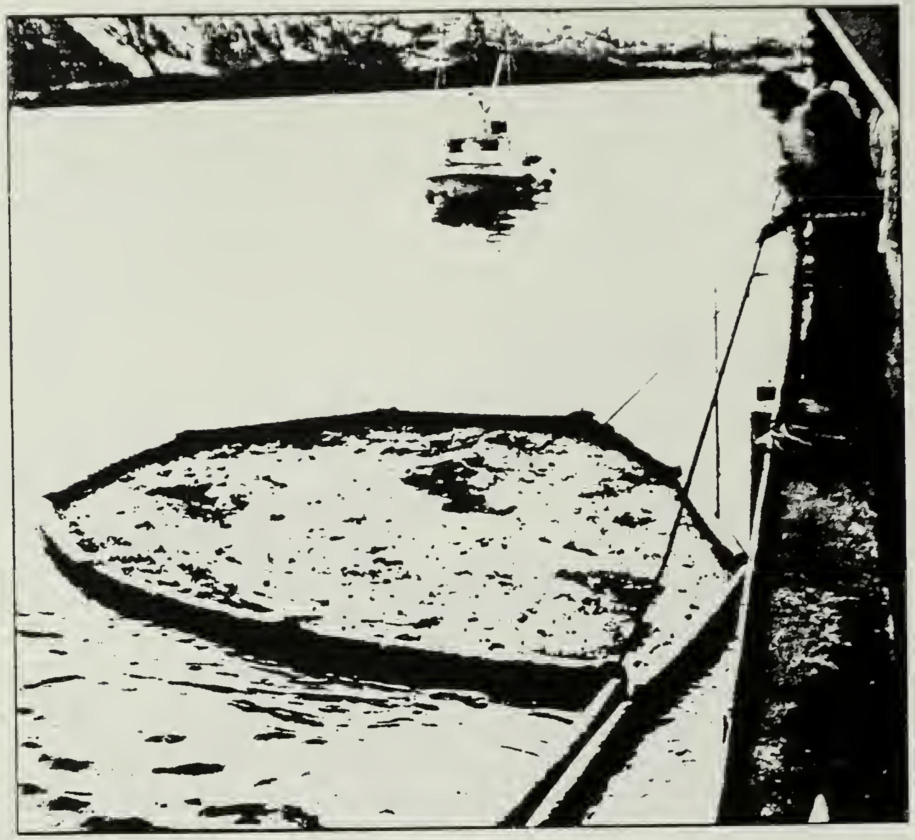
Bottom: The inverted Army dredge drag head, which allowed efficient removal of oil and debris, while minimizing the amount of water taken into the ships' hoppers.

attempts failed, primarily because it was impossible to maintain the necessary vacuum pressure on the relatively thin layer of oil.

To solve this problem, a crew member suggested that the drag head be rotated 180 degrees. This positioned the head's intake openings to face up instead of down. The inverted drag head was then placed just under the water's surface, and oil and water were drawn downward into the drag head. The initial attempt at oil recovery using the modified drag head allowed the recovery of more than 1,500 barrels of oil in less than 15 minutes.

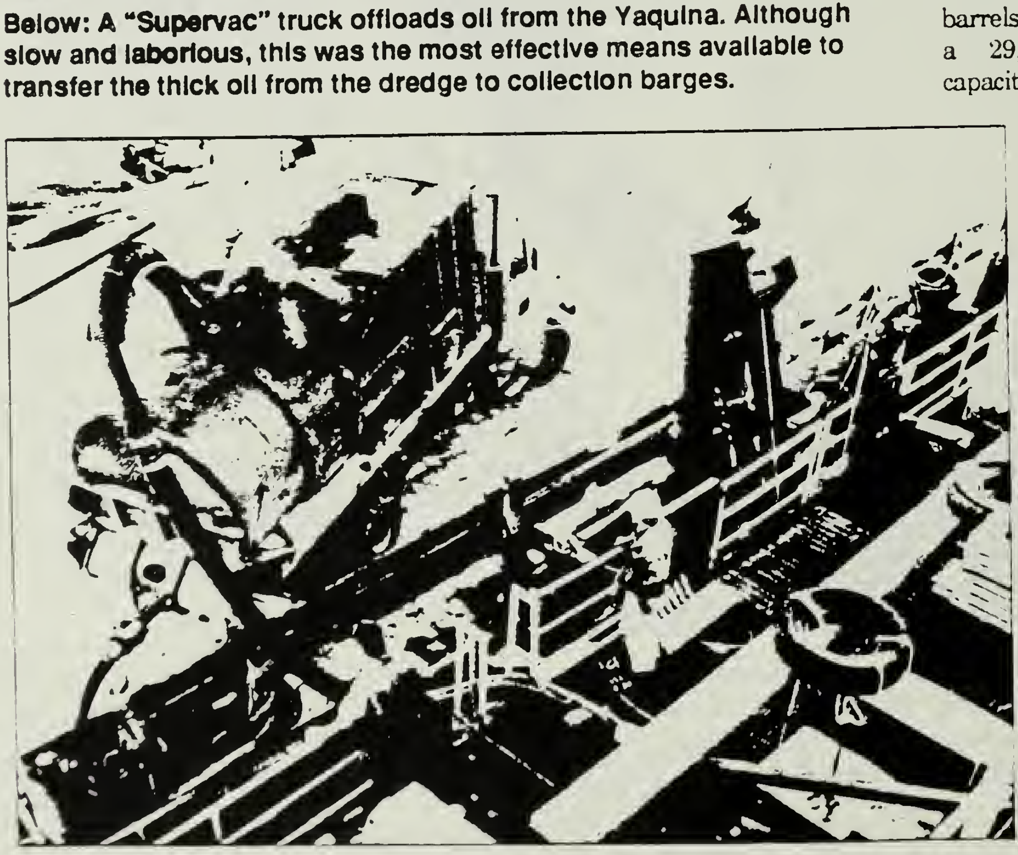
Oil Recovery

The most common method of recovering oil called for the use of an oil containment boom and two smaller vessels, usually fishing boats. The boats would maneuver an oil boom around a floating oil mass and enclose the oil in a



Above: An Army crewman maneuvers a small "donut," of oil, using ropes and a container boom. Such booms allowed the Army ships to place oil over the dredges' drag heads for collection.

Below: A "Supervac" truck offloads oil from the Yaquina. Although slow and laborious, this was the most effective means available to transfer the thick oil from the dredge to collection barges.



"donut." A typical donut was
proximately 200 feet in diam
and approximately one foot th
The oil in these booms was so t
that when a crewman pushe
shovel into the goo, it could no
pulled out again.

Since the drag arm does
move laterally out from the hu
a dredge, the booms w
maneuvered into a posit
against the ship's hull. Before
tivating the drag head, the por
of the boom against the ship
securely fastened to the hull.
rest of the boom was t
maneuvered to position the
over the drag head.

This method was not with
hazards. If the boom was
securely fastened to the hull,
powerful suction from the
head would grab the boom
damage it badly. Unfortuna
this happened several ti
during the course of reco
operations.

Both dredges had sufficient p
to pump the oil on board.
Essayons' pumping rate is about
barrels per minute, and the ship
a 29,000-barrel hopper st
capacity. The smaller Yaquina p
about 100 barrels
minute, and can store a
4,000 barrels.

During loading of
oil, the most critical f
was maintaining
suitable drag head de
If the head was locate
far beneath the surf
the oil, it would no
able to collect enoug
to be effective. If the
was too high, the su
force of the drag
would be lost becau
air being drawn int
system. Because
head position was so
cal, a drag arm pum
was assigned to contr
vertical position an
speed of the dredge p

The high volume of water taken aboard the dredges during the recovery process made it necessary to decant the oil/water mixture in the hoppers. Since oil is lighter than water, it naturally rises to the surface. As the oil/water mixture rises in the hopper, the level has to be monitored to ensure that it does not rise high enough to allow oil to escape through the hopper weirs.

Decanting was accomplished by opening one of the hopper doors 2 or 3 inches. This released water slowly, and when the desired level was reached, the doors were closed. A problem encountered during the operation was the large amount of debris, including wood, that was mixed with the floating oil. The wood had a tendency to get lodged in the hopper door openings, and sometimes prevented the doors from closing.

Off-Loading the Oil

Surprisingly, off-loading the collected crude oil mixture was almost a bigger problem than collecting it. The Essayons, because of its large storage capacity, did not have to unload until after the recovery operation was complete. The Yaquina however, had to off-load several times. Barges were provided to receive the collected oil and debris.

Because of the extreme thickness of the oil, it was impossible to off-load the dredges using conventional pumps. During the operation, several different pumps were tried—all with only limited success. A 3-inch submersible and a 3-inch diaphragm pump were placed on board the Yaquina at the start of the operation. Neither of these pumps was able to move the oil, which was so thick it wouldn't even flow toward a vacuum draw.

The largest pump used in off-loading attempts was a 12-inch centrifugal pump with 12-inch suction and discharge hoses. Even this large pump fell victim to the viscosity of the oil and the associated debris.

The most successful pump used for off-loading was the truck-mounted "Supervac." The Supervac is a vacuum truck typically used to empty sewage tanks or similar containments. The Supervac uses a large hose which can be readily moved around the surface of the material being removed.

Unfortunately, the oil and debris in the hoppers was so thick that suction from the Supervac's hose would create a hole in the material. The material was so viscous that often it would not even fill in the hole left by the Supervac. To get any results at all, crewmen had to constantly move the vacuum hose around the surface of the material. This was very time-consuming and physically demanding on the crew.

One of the limiting factors in using the Supervac was its small capacity. It would quickly fill with material from the hoppers, and would have to be emptied.

The vacuum truck was designed to discharge its load through a hose into a collection barge, although this proved to be a troublesome and lengthy procedure. The crew of the Yaquina speeded the process by constructing a large rectangular box around the barge's hatch opening. This allowed the truck to open up its rear like a dump truck and discharge its load directly into the barge.

While other off-loading options were tried, the problem of transferring oil from the dredges to barges was never totally resolved. Hopefully, further study will ensure that an effective off-loading method is available for use in future dredge oil-recovery operations.

The Final Analysis

Army hopper dredges played an important role in the Valdez oil recovery effort. The Essayons and Yaquina remained in Alaska until mid-July, when they returned to their normal west coast dredging duties. During their duty as oil recovery vessels, they recovered nearly 380,000 gallons of oil.

In addition to oil collection, the dredges proved their versatility by supporting other operations crucial to the recovery effort. The dredges were able to act as command and control vessels with full communications capabilities, as mother ships to fleets of smaller vessels (by supplying fuel, water and other supplies), and as rapidly deployable work stations with full housekeeping services.

While equipment and procedures need to be fine-tuned, the Valdez operation proved the value of the hopper dredges. And they remain an effective option for meeting the challenge of oil recovery operations.

Captain Heaton is a project manager for the Defense Environmental Restoration Branch of the Alaska District. He previously served as a company commander with the 43rd Engineer Battalion. Other assignments include liaison officer for the Directorate of Combat Developments, Infantry School, and platoon leader and executive officer in the 5th Engineer Battalion. He is a graduate of the Engineer Officers Advanced Course, and the Combined Arms and Services Staff School. He holds a degree in civil engineering from Carnegie Institute of Technology.

Dust Control in Saudi Arabia

Dust has always been a headache for tactical units, particularly armor, mounted infantry and aviation. It obscures battlefield vision, coats sighting instruments, and gives the enemy an excellent location signature. And that's in addition to the usual maintenance problems associated with all the grit.

Of course, there's not much you can do about dust on the battlefield. But initial reports from Operation Desert Shield have indicated deeper than usual effects on the full range of Army field operations. From aviation parking areas to refueling points, and field billeting areas to maintenance parks, dust is making itself an unwelcome guest.

Imagine yourself an engineer on the ground in that region. You're in a brigade tactical operations center (TOC), and an aviator has just finished briefing the commander. The aviator has indicated that his Blackhawks were unable to take on JP4 at a refueling point because of heavy dust swirling around the immediate area. The colonel shifts in his chair, looks over his shoulder, finds you, and says matter-of-factly: "Fix it!"

You wouldn't be alone. There have been many r quests to the Engineer Center for technical assistance and advice on dust control in Saudi Arabia. While most organized studies on soil behavior and dust assume a temperate or tropical environment, r search done by the Center's Department of Military Engineering has highlighted the demanding nature that country's climate and geology.

The Saudi Climate

Saudi Arabia has the internal drainage pattern typical of arid regions. In more temperate climates, water systems are the prime mover of so particles. The finer the particle, the further it moves with the finest ones eventually finding their way to sea. With interior desert drainage, as in Saudi Arab what little rain there is simply moves fine soil particles to the center of the desert bowl. Arid regions are thus collectors of these dust-sized particles. An with the massive size of the Saudi desert, that

By Major Michael F. Hullihan

country has one of the largest collections of dust in the world.

Wind is a constant feature of the desert climate. High daily temperature ranges (from 77 to 130 degrees Fahrenheit), and great regional temperature variations cause continuous pressure gradients. The resulting winds are the primary vehicle for moving soil.

Normally, any particle under 4 millimeters (mm) is subject to movement by wind. As soil particles are blown across the desert surface, they are gradually worn to very small sizes—typically less than 0.06 mm.

Because of these conditions of extreme heat, low humidity, high winds, and uniformly small sand grains, soldiers taking part in Desert Shield routinely face dust problems much worse than those encountered at the National Training Center (NTC), in the Mojave Desert.

Available Methods

Several references are available for technical guidance on dust control, including TM5-330, TM5-830-3, and FM5-541. However, after considering the harsh Saudi environment, the number of workable options is drastically reduced. Let's look at some of the available methods and their potential usefulness in the Desert Shield environment:

Mats and Membranes. Airfield matting like M19 and AM2, and membranes like T17, will effectively prevent dust. Their only drawback is cost. Since it isn't feasible to mat all areas adjacent to runways and helipads, additional control methods are needed for areas surrounding the matting.

Bituminous Products. These include asphalt cutbacks, asphalt emulsions, and road tars. Bituminous products act as adhesives in the soil mass. They will prevent dust as long as the treated surface layer is not broken by vehicles or aircraft.

Bituminous materials may be applied as a penetration treatment or an admixture. For a penetration treatment to be effective, the soil must be sufficiently free of fines to allow adequate penetration depth. In extremely fine-grained soils like those in Saudi Arabia, such treatments produce a thin crust of bituminal soil which is only effective in nontraffic areas.

In an admixture application, the soil is scarified, and a bituminous product is sprayed onto the soil. After mixing by windrowing, harrowing, or rototilling, the treated soil is shaped with a motor grader. Compaction with a rubber-tired or sheepsfoot roller completes the treatment. The admixture method strengthens the soil and acts as a dust palliative.

In choosing between a bituminous penetration treatment and an admixture, the realities of an operational environment must be considered. Vehicle operators have a natural tendency to drive on anything that looks black. Even if an area is designated as nontraffic after treatment with a penetration application, vehicles will traverse the area unless effective measures are taken to restrict traffic.

Bituminous products are the cheapest form of dust control, costing about $1.80 per square meter for an admixture. Asphalt emulsions are performing very well in Saudi Arabia, although caution must be exercised with mix water. Good results can be obtained with commercial, premixed emulsions, but the use of local brackish emulsion water can cause premature breaking and ruin distributors.

Helicopters with skids also present a special problem for bituminous surfaces. Skids tend to "knead" a bituminous surface, eventually causing it to fail. Helicopters with skids should be parked on matting or coarse aggregate.

Coarse Aggregate. Coarse aggregate with a uniform gradation of about 5 inches serves as both a good bearing surface and a dust palliative. When placed in a 12-inch-thick lift, this coarse aggregate functions well as a helipad. Grain size should be no less than 3 inches to avoid foreign object damage (FOD) problems.

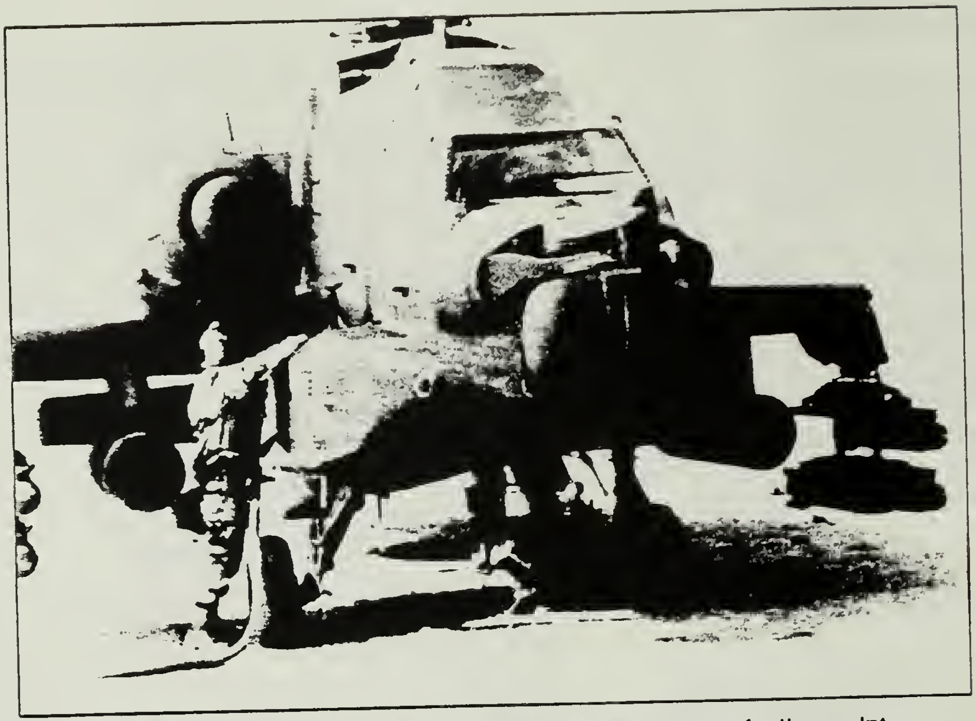
Vegetation and Deflation Armor. Vegetation acts as a natural dust agent. Similarly, the rocky crust (or deflation armor) found in deserts is an effective dust palliative until it is disturbed. Again, control of vehicle traffic can help preserve this natural cover and reduce the scope of dust problems.

Resins. Petroleum-based or naturally occurring resins (like lignin) work like bituminous products. Resins are applied as penetrants or admixtures, and their performance is comparable to bituminous products. Organic resins such as lignin are environmentally safe, and they do not discolor the soil as much as bitumen. These characteristics may justify the use of resins in special circumstances, despite their higher cost of about $4 per square meter.

Brine Solutions. Salt solutions, including CaCl, MgCl and NaCl, suppress dust through two mechanisms. First, they pull moisture from the air, causing dust particles to stick together. But this will occur only if the relative humidity is higher than 30 percent. A second effect of brine solutions is the formation of a salty crust on the soil. If it remains unbroken, this crust can be effective in reducing dust.

But conditions in the Saudi desert do not support the use of brine solutions. Relative humidity is near zero everywhere except coastal regions, and heavy traffic makes the life expectancy of a brine dust-suppression application very short.

Cement and Lime. Cement and lime hydrate in the presence of water and form a soil-cement mass which will reduce dust. However, this technique is sensitive to the quality and amount of water used. In



Swirling dust around support operations like this helicoptor refueling point can impede combat operations. Properly employed, available dust control measures can minimize airborne soil particles.

an arid climate like Saudi Arabia, getting enough potable water into the soil mass and mixing it sufficiently is difficult. In more tropical regions, existing water in the soil usually makes up for the lack of added water. In the desert though, the cement and lime will remain anhydrous, and could even add to the dust problem.

Crude Oil and Waste Oil. While reference manuals list applications of crude or waste oil as a temporary dust palliative, these products should be used only as a last resort. Unlike graded asphalt or tar cutbacks, oil does not cure and adds no structural strength to the soil. Since it remains liquid, oil tends to turn loose soil into a black, oozing mass which coats vehicles, equipment and personnel. Too, the presence of oil makes subsequent use of bituminous products less effective.

We must also be sensitive to the environmental concerns of the host nation. While graded bituminous products cure to form a stable type of soil asphalt concrete, oil remains liquid and must be regarded as a potential pollutant.

Planning Considerations

Based on the preceding evaluation of techniques, here are some general recommendations for dust control in Saudi Arabia:

- Bituminous treatments in admixture application are fective. Ensure the depth admixture layer is greater than potential ruts (4-inch minimum).
- Resin products, such as nin, are effective when used as admixtures. For special use areas, the neutral color and biodegradable nature ma justify the greater cost.
- Mats and membranes eff tively control dust in aircr landing and parking areas Adjacent areas subject to rotor or prop wash must receive a dust palliative.
- Uniformly graded coarse aggregate performs well both a wearing surface a dust palliative.
- Restrict traffic from deflation armor areas or area protected by a penetration spray.
- Avoid brine solutions and cement/lime mixtur
- Include dust control analysis as an engineer planning factor.

We know there's not much that can be done abo battle-generated dust. But we can initiate significant dust control measures designed to improve support operations and troop health and welfare. The last th a battle-bound helicopter needs is to be hampered its refueling attempts by heavy dust at the refueling point. And anyone who's spent much time in a win desert environment can appreciate what it means t have some respite from the sand and grit that cons ly filters through your tent and sleeping bag.

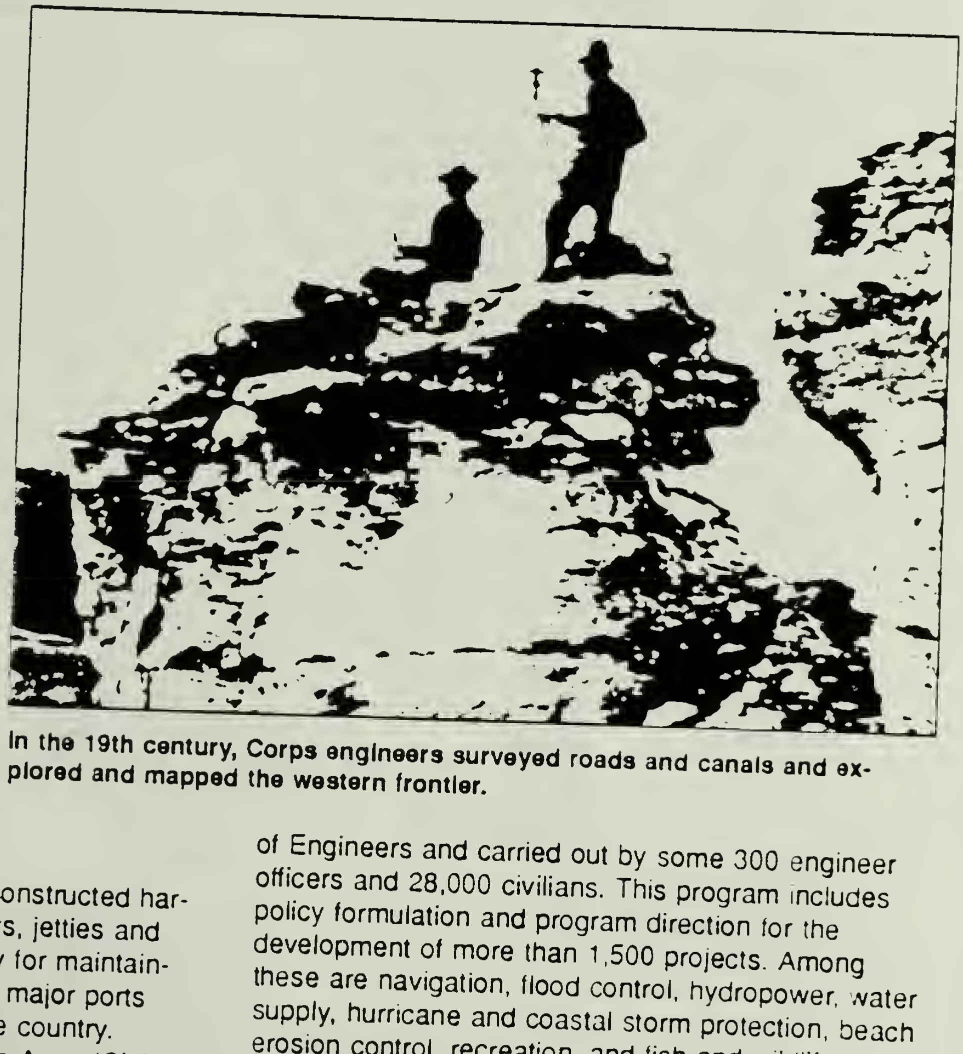
Successful dust control in Saudi Arabia sounds an impossible pipe dream. But through sound engineer analysis, and learning from early field expe ces, engineers are finding solutions to the proble

Major Hullihan is assigned to the Combat Const Division of the Engineer School's Department of Engineering. He previously served as executive off the 35th Engineer Battalion. He has also served as talion S-3, company commander, and deputy distr gineer for the Army Corps of Engineers, New Orlea trict. He is a West Point graduate, and holds a m degree in civil engineering from the University of Illin

CIVIL WORKS—

ANOTHER SIDE OF THE ARMY ENGINEERS' MISSION

Civil works is a broad-range, ever-changing mission of the Corps of Engineers that provides exciting challenges for young engineer officers. Many senior officers in the Corps will tell you that the best assignment they ever had was that of a district engineer involved in civil works.



In the 19th century, Corps engineers surveyed roads and canals and explored and mapped the western frontier.

The Corps' History

In 1824, our nation struggled to open up and develop new lands west of the Appalachian Mountains. To aid in this effort, the U.S. Congress authorized President James Monroe to direct Army engineers to survey roads and canals needed for commercial, military, or postal purposes. In that same year, Congress authorized the first projects designed to improve navigation on the Mississippi and Ohio Rivers, accelerating the newly emerging westward movement.

During this period, the Corps also constructed harbor improvements such as breakwaters, jetties and piers. The Corps still has responsibility for maintaining federal channels in more than 100 major ports and 400 small boat harbors around the country.

Today, the Assistant Secretary of the Army (Civil Works) is responsible for all aspects of the Army Civil Works program, which is implemented by the Corps of Engineers and carried out by some 300 engineer officers and 28,000 civilians. This program includes policy formulation and program direction for the development of more than 1,500 projects. Among these are navigation, flood control, hydropower, water supply, hurricane and coastal storm protection, beach erosion control, recreation, and fish and wildlife conservation. The Corps also helps to regulate wetlands and navigation, and provides emergency response to natural disasters.

By Major General Patrick J. Kelly, Director of Civil Works

The largest shipment military equipment on inland waterways sinc World War II moved through Lock and Da 4, on the Arkansas River, in 1989. The equipment was enrou to the Joint Readines Training Center at Fo Chaffee. (Photo by P. Spaul)

Since passage of the Flood Control Act of 1936, the Corps has built about 400 flood control dams and thousands of miles of levees, floodwalls, floodways and channels. While costing more than $25 billion, these flood control facilities have saved more than $175 billion in damages. This equates to the prevention of $7 in damages for every $1 spent.

The Corps' civil works program has helped move America forward over the years. Today, in order to meet the needs of the nation and the world, an environmental ethic must be integrated into the way the Corps conducts its business.

The Corps is committed to promoting environmentally sustainable development while continuing to build and support our national infrastructure. The environmental consequences of Corps operations are an important part of the organization's decision-making process. In other words, environmental issues are more than simply a consideration; they are part of the "go-no-go" test along with economics and engineering.

The Districts

District assignments are challenging and demanding. They provide an opportunity for an officer to exercise a full range of leadership, engineering, and construction skills.

There are 39 districts in the Corps of Engineers, and 37 of them have civil works missions. Districts are organized like mini-installations and are primarily staffed with civilians. The staffs range in size from 200 to 1,800 personnel and include from two to 20 military officers.

Company grade officers are usually assigned to construction field offices, where they gain experienc in construction contract supervision and administration. The names of each field office reflects the qua tity of work supervised, and include area, resident, project offices.

Military officers supervise all aspects of contract management, including construction quality control, safety, change order negotiation, dispute resolution, and warranty enforcement. After they are fully school in field operations, officers may move to the district o fice to learn other aspects of district operations. Dutie as a project manager in either a construction or engineering division would be a typical assignment.

A district assignment is a career-broadening experience that provides an opportunity to work with civilian work force. Such assignments prepare offic for future field grade assignment as a deputy or co mander in a district. They also allow officers to app their technical engineering education to the solutio of complex problems.

1986 Water Resources Act

The Water Resources Development Act of 198 was the first major authorizing legislation for civil works in 16 years, and it fundamentally chang federal water policy. Besides authorizing many ne projects, this act included new cost-sharing rules f nonfederal participation in project funding. Basic policies introduced by this law will profoundly affect Corps water resources development for many years to come. As a result, Corps' district engineers and their staffs now work closer than ever with various project sponsors on all phases of a project, including planning, design, and construction.

Numerous harbor-deepening projects have been started, and many have been completed, since this act was passed. New projects include those at the ports of Baltimore, Mobile and Norfolk. Because these projects require significant involvement with local agencies, strong partnerships have been forged between the Corps and individual project sponsors.

Flood Control

Large-scale flood control projects are also underway. The $1.35 billion Santa Ana River flood-control project in California consists of two large dams and 50 miles of channel. It will provide flood protection for a three-county area near Los Angeles, one of the fastest growing regions in the nation.

The Passaic River flood-control project, in northern New Jersey, is in the design stage. It will provide an innovative solution to flood control that involves two diversion tunnels, as well as some channel modifications, levees, and flood walls.

With opportunities such as these, today's engineer officers can gain excellent experience in all phases of construction management. Training in the construction management of navigation, flood control and other projects prepares officers for a wide variety of assignments.

National Emergencies

The Corps has a proud history of responding to the nation's needs in time of emergency or disaster. Response can be under the Corps' own statutory authority for floods, hurricanes or coastal storms, or it can be in support of other agencies, such as the Federal Emergency Management Agency (FEMA).

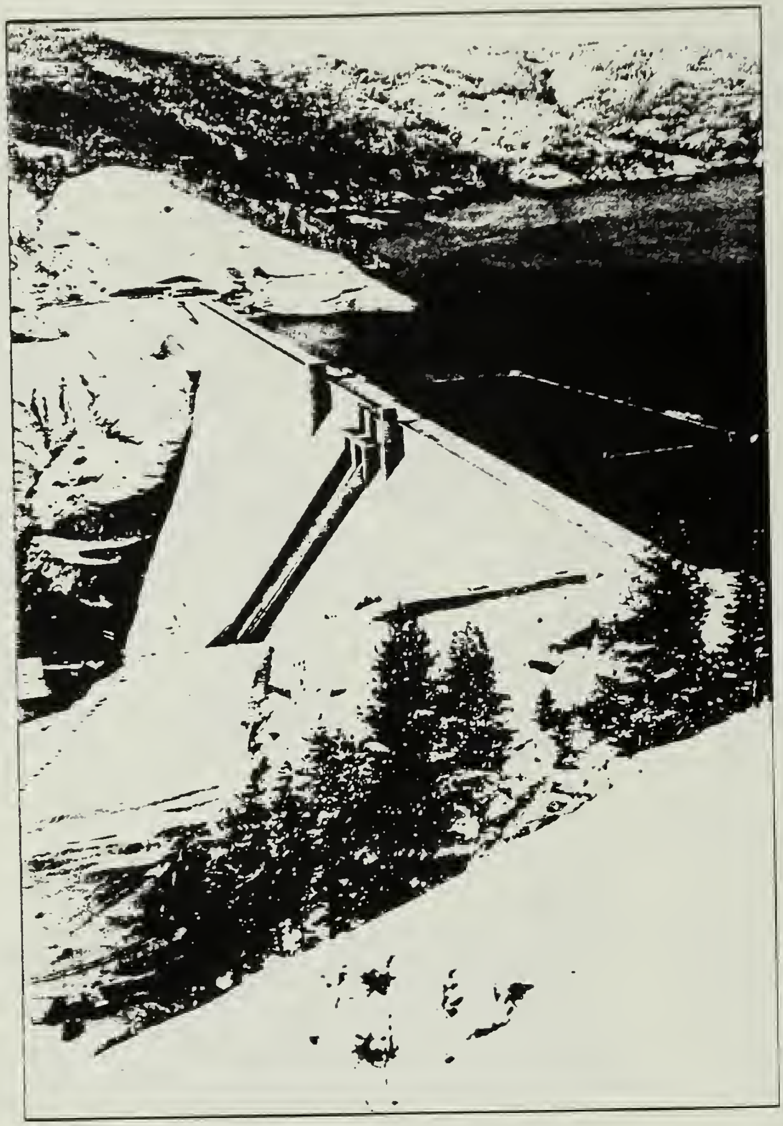
Corps assistance often includes long-term recovery efforts to meet public needs. To accomplish these response missions, the Corps is heavily involved in the development of necessary plans, training of response personnel, testing, and coordination of all these efforts with affected federal, state, and local entities.

Another important responsibility of the Corps' civil works mission is responding to major emergencies that have an impact on our nation's security. Toward this end, the Corps has developed its National Security Emergency Preparedness (NSEP) program, which is designed to meet defense and essential civilian needs during any national emergency. The Corps, in coordination with state, local and other federal agencies, has prepared support plans that can be implemented both here and overseas.

Resource Protection

Civil works projects also provide public recreation facilities featuring boating, swimming, fishing, hunting, camping and hiking. The Corps manages more than 2,000 separate recreation areas at 472 water resource development projects in 41 states. Next to the U.S. Forest Service, the Corps is the second largest

The Corps of Engineers has a proud history of responding to national emergencies. Here, crewmen offload oil from an Army dredge during the Valdez, Alaska, clean-up operations. Corps' dredges pulled in about 7,000 barrels of oil as part of the clean-up activities.



federal provider for recreation opportunities.

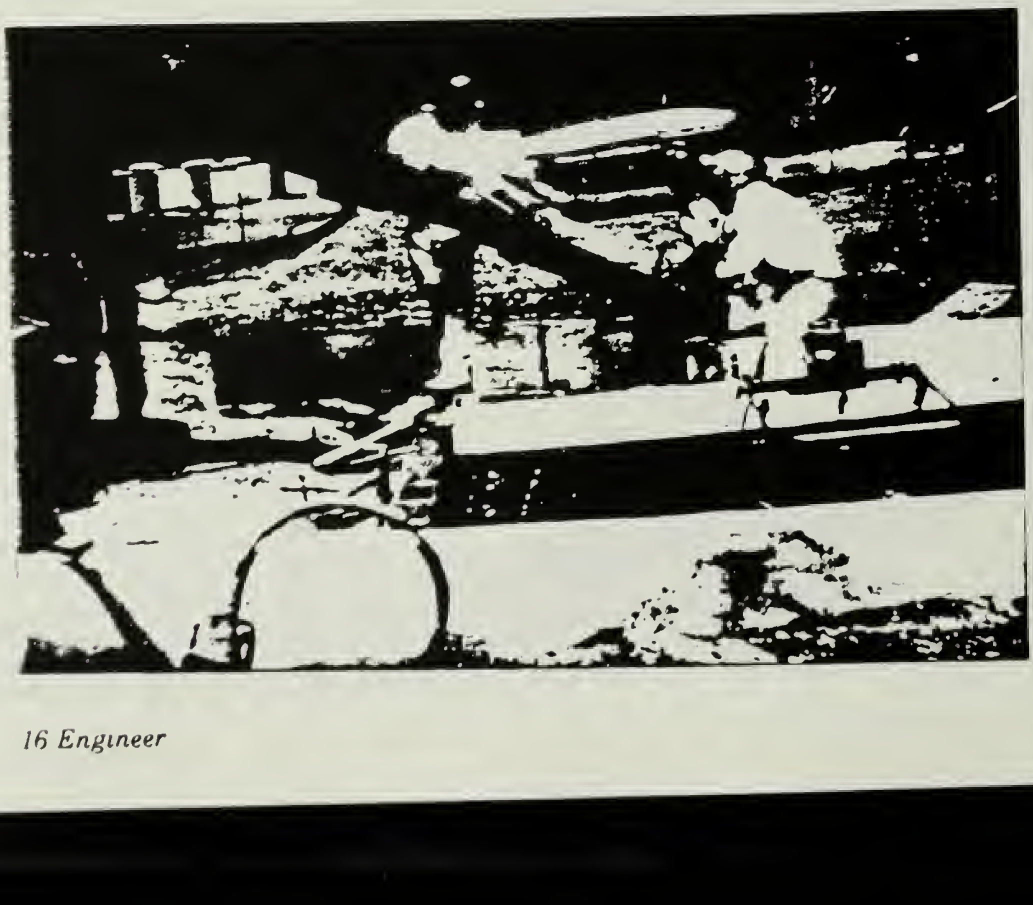
Corps multiple-purpose projects have provided many communities with their prime source of drinking water. In meeting water supply needs, the Corps has impounded more than 9,000,000 acre-feet of water in 101 lakes throughout the United States.

The Corps also has been active in shoreline protection and in developing new technologies in this area. Both structural and nonstructural measures are used to protect the country's seacoast and shores of the Great Lakes from erosion and hurricane or storm flood damage. Structures include groins and breakwaters. No structural measures, such as adding sand or planting beach grasses, are often more economical and practical.

By conducting civil works programs during peacetime, the Corps ensures its readiness fo potential mobilization. It also allows engineer ficers an opportunity to represent the Army to portions of the American public who might not otherwise have contact with the Army.

Research

As its missions expand, the Corps of Engineers is seeking new ways to do its job better. Research to support the civil works effort, as well as military construction, is carried out by some 1,200 scientists and engineers at four maj research centers. Officers with an interest in the practical application of scientific principles, and who possess training in a related discipline, will find these assignments challenging and rewardi



Top left: Idaho's Dworsh Dam is one of the larges dams ever built by the Corps of Engineers. Thi multipurpose project provides flood control, hydropower, and navigation opportunities.

Left: The Corps often works with other agenci when cleaning up toxic materials. These Corps sonnel, in cooperation the Environmental Prote tion Agency, are cleanin up hazardous waste.

The Army Construction Engineering Research Laboratory (CERL) in Champaign, Illinois, works with the University of Illinois in conducting research and engineering studies in materials, energy, construction management and environmental quality.

The Army Engineer Topographic Laboratories (ETL) at Fort Belvoir, Virginia, is committed to advancing state-of-the-art technology in geodetic, topographic and geographic systems for the Army and Department of Defense. The Global Positioning System, a well-known battlefield aid, was used by ETL researchers to develop a precise structural tool to measure deformation on large dams.

The Army Cold Regions Research and Engineering Laboratory (CRREL) in Hanover, New Hampshire, supports civil and military construction through research, investigations and engineering studies of cold environments, including the mechanics of snow, ice and permafrost. CRREL supports civil works programs by studying methods to control the impact of ice on navigation structures and the effect of ice and snow on the environment.

The Waterways Experiment Station (WES) in Vicksburg, Mississippi, pursues a spectrum of activities in six component technical laboratories.

- The Hydraulics Laboratory studies flood control, navigation and sedimentation problems in waterways and harbors.
- The Structures Laboratory studies the response of structures to various kinds of stress.
- The Environmental Laboratory investigates the effects of water resources development projects on the environment, and the interaction between military activities and the environment.
- The Coastal Engineering Research Center provides national expertise in coastal engineering to help solve navigation, coastal flooding, beach erosion, storm protection and marine construction problems.
- The Geotechnical Laboratory studies soils, pavements, off-road mobility of military vehicles, earthquake effects and engineering geology.
- The Information Technology Laboratory does research, development, and support in interdisciplinary computer-aided engineering fields and computer science fields.

The Corps also has entered into a new research and development (R&D) partnership with the nation's construction industry to make it more competitive with foreign firms. This partnership, referred to as construction productivity advancement research (CPAR), is making Corps R&D labs available to industry for research, development and the application of advance technologies through cooperative research, field demonstrations, licensing agreements and other forms of technology transfer.

As part of its over-all civil works mission, the Corps is working with the Federal Railroad Administration in the development of a high-speed, high-tech, surface transportation system. This system is designed to move large numbers of passengers over distances up to 600 miles at speeds of 300 miles per hour, or more. The technology, known as magnetic levitation (MAGLEV), would use magnetic force to lift and propel train-like vehicles on guideways in a manner that is safe, energy efficient and environmentally sound.

Infrastructure Upgrades

In addition to the work on MAGLEV, the Corps, has set up an infrastructure task force. This group will help implement a strategic plan to assist the nation in upgrading its infrastructure, including navigation facilities, flood control structures, waste water management, solid waste management, hazardous-toxic-waste cleanup, and other environmentally sensitive work. During FY 1991, the Corps will open discussions with federal, state and local agencies and private sector officials to develop a national strategy for America's infrastructure needs.

Closely tied to the question of infrastructure is the development of a public-private partnership to provide environmental services that have traditionally been the responsibility of state or local governments. This could include drinking water supply, wastewater management, and solid waste disposal. The Corps is working with the Environmental Protection Agency to increase private sector involvement in these areas.

As the nation prepares to enter the 21st century, it faces many of the same problems that confronted a young and restless America in the early 19th century. Today, in addition to navigation and flood control, there is a whole range of challenges associated with protecting and restoring the environment, rebuilding the national infrastructure, and making sure that adequate water resources are available to serve the needs of our nation and the world.

Through civil works projects the Corps will continue to be part of the effort to strengthen this nation. Officers assigned to civil works projects can expect exceptionally rewarding challenges and the opportunity to make a significant contribution to our country's future.

Major General Kelly is currently assigned as Director of Civil Works in the Office of the Chief of Engineers, U.S. Army Corps of Engineers. Previous assignments include Commander and Division Engineer of the Corps' South Pacific Division; and Commander, U.S. Army Engineer District, Mobile, AL.

Engineer Problem

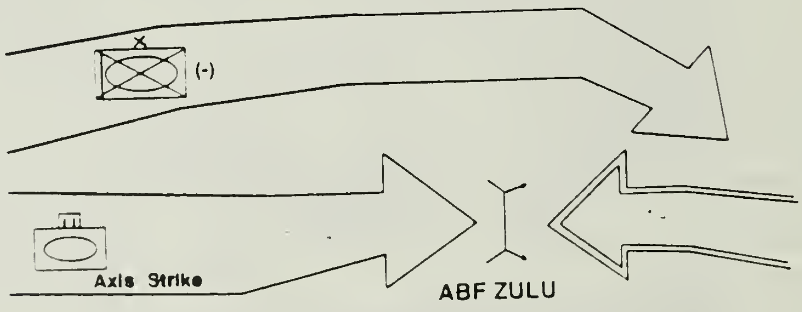
This is the first of four engineer problems dealing with breaching operations; the remaining three will appear in future issues of ENGINEER Professional Bulletin. The problems reflect concepts outlined in FM 90-13-1, Combined Arms Breaching Operations, *which is scheduled for distribution in the 2nd quarter of 1991. Each will focus on a particular type of breaching operation: in-stride, deliberate, assault, and covert.*

The scenario depicted in each problem illustrates specific teaching points on that type of breach. An excerpt from FM 90-13-1 is provided to describe the characteristics of the breach and when it will be used. The problem-solving process is presented using the engineer estimate process and includes some key discussion points. Our first problem focuses on an in-stride breach.

As the task force (TF) engineer and engineer company commander, you are to recommend a task organization of mobility assets to the TF tank commander. The intent is to organize the task force for an in-stride breach from phase line (PL) Red to PL Blue.

SITUATION: You are the commander of Company A, 52d Engineer Battalion (Co A/52d EN Bn), a divisional combat engineer company. Your unit is attached to TF Tank for their offensive operation. The brigade's mission is to destroy an attacking motorized rifle regiment (MRR), which is being committed into your area of operations. Your TF mission is to lead the brigade's attack through a defeated main defensive belt and destroy the MRR's vanguard of motorized rifle battalion (MRB(+)) strength. This will allow the main body of the brigade to pass through and destroy the MRR's main body.

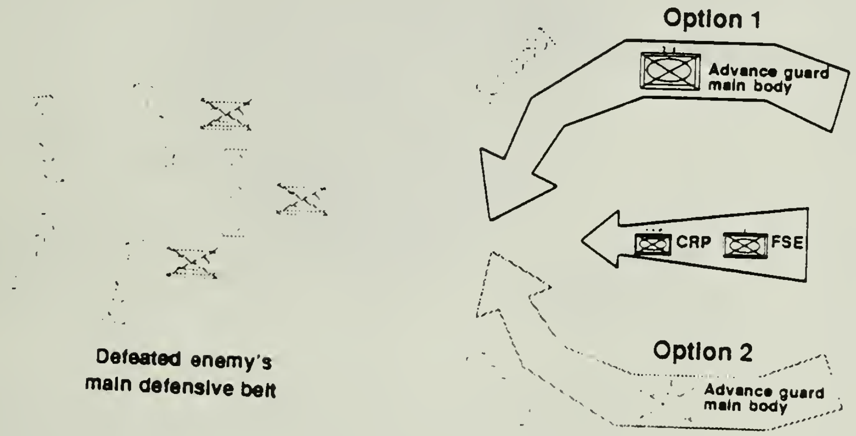
TF Tank is to attack along Axis Strike and destroy the lead MRB(+), as shown on the Brigade Operations Overlay. The TF commander expects a meeting engagement and believes the key terrain near attack by fire (ABF) ZULU will give his force a needed advantage. The commander focuses his TF planning on conducting a movement to contact that will end in a meeting engagement.



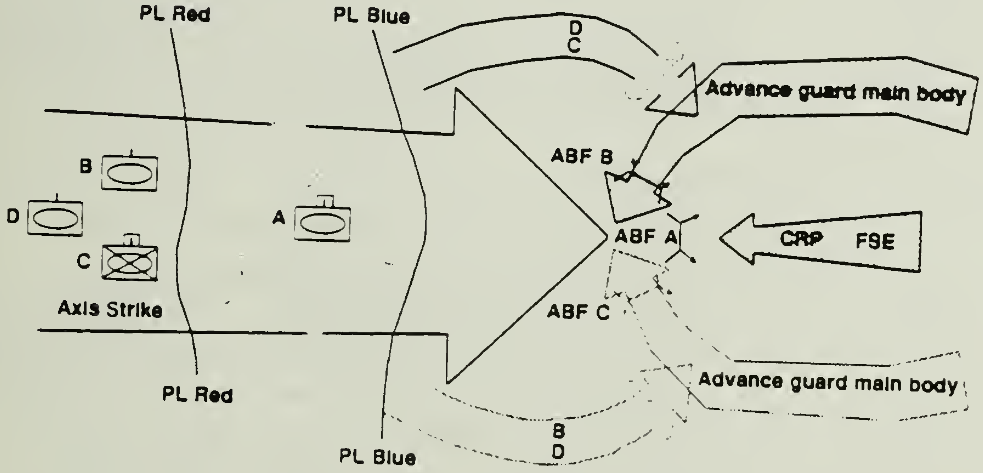
Brigade Operations Overlay

Engineer Problem

As a result of the intelligence preparation of the battlefield (IPB) process, you and the intelligence officer (S-2) developed the enemy Situation Template, below. The TF commander selected the maneuver plan shown on the Task Force Operations Overlay.



Situation Template



Task Force Operations Overlay

The plan is designed around rapid maneuver on Axis Strike to attack by fire positions that will fix the enemy's combat reconnaissance patrol (CRP) and forward security element (FSE). The company/team moves to the appropriate ABF position in order to fix the advance guard main body. The TF's main effort will shift to forces in the TF's main body as they attack into the flank of the advance guard's main body. The TF's main body will deploy either north or south, depending on the situation developed by the TF's advance guard.

Engineer Problem

During the planning process, the commander and staff identified rapid movement through a previously defeated MRB main defensive belt (PL Red to PL Blue) as an essential implied task. Because rapid movement is critical and the obstacle and enemy situation in this area are relatively unknown, the TF commander gave you guidance to organize his mobility assets for an in-stride breach.

Engineer Solution is on page 29.

In-stride Breach Description

Definition: A force breaches in-stride when the breach operation can be successfully executed under the complete command and control of a task-organized subordinate unit.

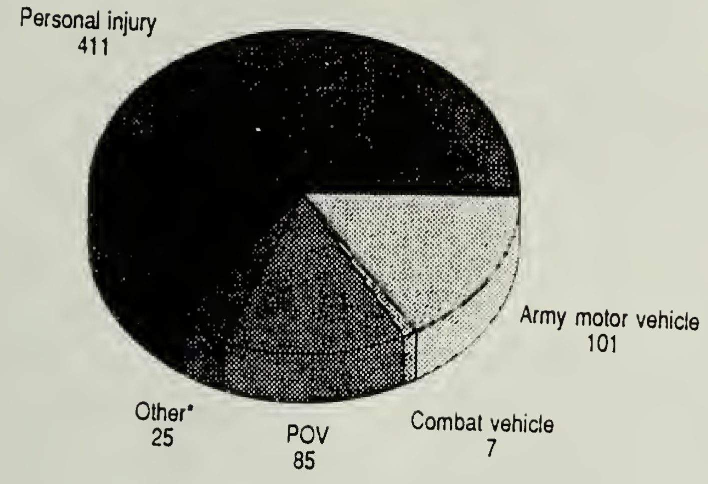
A commander uses an in-stride breach when—

- The situation is unclear (enemy and friendly obstacle locations are unknown) and several lead subordinate units are capable of independent breaching operations to accomplish the mission.
- The enemy's defense (obstacles and fires) is so weak that the forces required to support, breach, and assault can be task-organized into a subordinate unit. Breach success does not require the maneuver of other subordinate units to adequately suppress, secure, or reduce the obstacle.

Characteristics:

- Breach is conducted at the subordinate level.
- The brigade or task force is capable of quickly overcoming unexpected or lightly defended obstacles.
- The resources necessary for independent application of suppress, obscure, secure, and reduce (SOSR) are allocated to the task forces, companies, or teams.
- Application of SOSR and breach synchronization are the subordinate commander's responsibility.
- Mobility assets (engineer and maneuver) are generally decentralized to support independent breach operations.
- Maneuver and engineer plans address the quick transition to a deliberate breach; the engineer maintains a mobility reserve that can shift to any location required.

Engineer Accident Review for FY



Total Accidents, FY 90 = 629

Cost = $10, 170,000

*18 Other Army vehicles, 4 fire, 3 explosives

The number of accidents involving engineer soldiers increased in fiscal year (FY) 90, reversing last year's downward trend. The narratives of accident reports tell what can happen when standards are not enforced and adequate supervision is not provided. They also show areas where we must improve our performance.

Statistics tell the story. As of October 29, 1990, there were 629 engineer-related accidents reported, compared with 608 in FY 89. The good news is that accident costs dropped 13 percent during the same period—from $11,120,000 in FY 89 to $10,170,000 in FY 90. This article focuses on the major types of engineer accidents and countermeasures we can take to reduce their number.

There were 23 fatalities involving engineer soldiers in FY 90, compared with 24 in FY 89. Two of them occurred in an M9-ACE accident; these were the only training fatalities. Of the others, 19 occurred in privately owned vehicles, one in a fall from a cliff, and one soldier was struck by a train. Another, not included in the above total, involved a civilian who was run over when a road grader backed up on a construction site.

Personal injuries, 65 percent of all accidents, included mainly human locomotion (walking and running) and sports accidents. Other top accident producers in this category are material handling, maintenance, and tactical parachuting.

Human locomotion and sports made up 24 percent of all engineer accidents. Poor housekeeping or police of the work area caused most of the human locomotion accidents; they occurred when an employee fell, slipped or tripped while walking. Leg and ankle injuries incurred during touch football and basketball games produced most of the sports injuries. We can reduce these accidents by following proper procedures—on and off the job.

Material handling injuries center around soldiers who work with loads that are being moved with engineer equipment. Narratives from these accident reports describe poor communications/supervision between operators and handlers. Frequently hand signals and ground guides were not used or were used improperly. Supervisors must ensure ground guides are used properly and that hand and arm signals are understood by all soldiers involved in the operation.

Most of the maintenance accidents occurred while soldiers were installing repair parts or repairing tires. Here, too, failure to follow proper procedures was the underlying cause.

Tactical parachuting remains as the top combat soldiering accident producer for engineers. Poor exits and improper PLFs are major problems. The Safety Center is involved in several tactical parachute awareness and equipment challenges aimed at improving the safety of this mission.

Of the engineer Army motor vehicle (AMV) accidents, almost 30 percent involved 5-ton trucks, and most were caused by operators who failed to follow established procedures.There was an average of two dump truck accidents every month. Failure to use ground guides, speeding, and disregard of traffic rules were major causes. These are areas supervisors can influence. And, an exportable training package for 5-ton vehicles, recently released by the Transportation School, is aimed at improving driver awareness.

(Continued on page 43)

Some of the Best Training Anywher

The Latin American theater gives the Army, and engineers in particular, some of the best training available anywhere in the world. And like the proverbial two-edged sword, it gives soldiers the chance to hone their military skills and, at the same time, improve the quality of life for local civilian populations.

Honduras is one of the most active areas for such dual-purpose military deployments. A close relationship with the United States and a long string of productive U.S. operations there have made the Central American country a favorite for military and nation assistance missions.

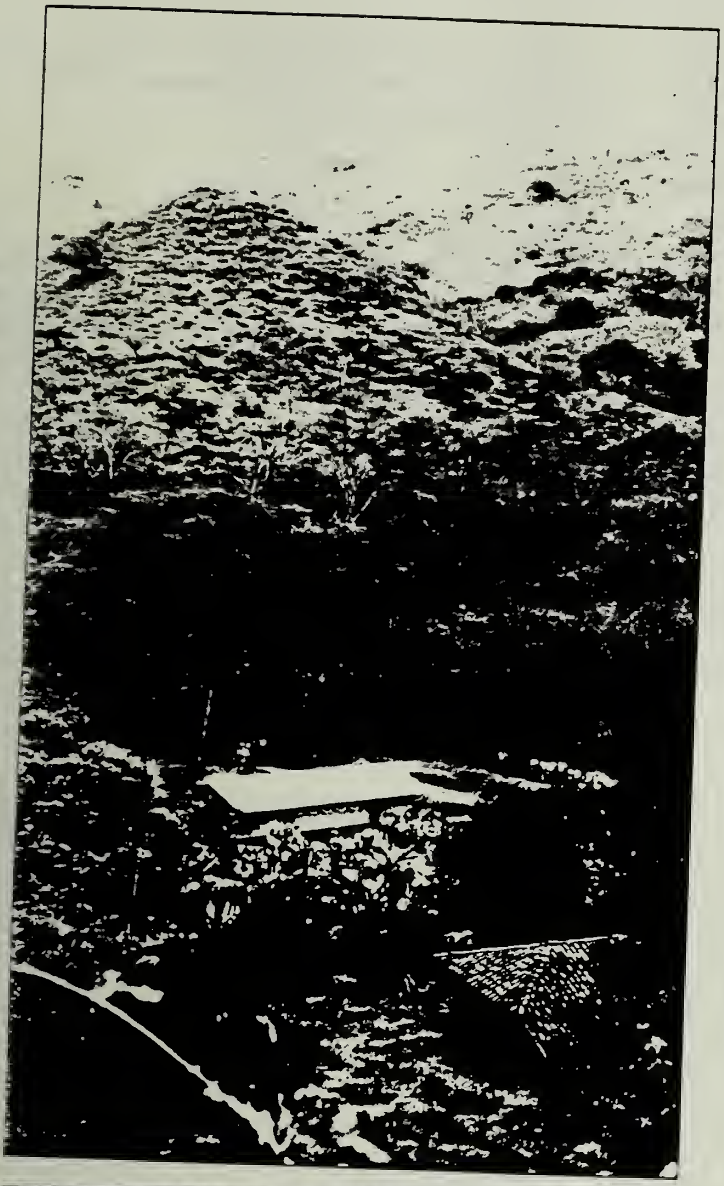
Early last year, the 27th Engineer Battalion from Fort Bragg deployed to Honduras for a three-month tour. Both military construction and nation assistance missions were completed by the unit as part of the Joint Chiefs of Staff exercise Ahuas Tara '90.

The battalion headed a task force of more than 1,000 soldiers. Giving additional muscle to the airborne unit was Alpha Company of the 92d Engineer Battalion (Combat) (Heavy), which provided heavy engineer equipment and concrete mobiles, an asphalt spraying capability, and sorely needed compaction equipment. Additional haul assets were provided by the 264th Assault Bridge Company (MGB). Logistics support was provided by a composite force under the control of the 189th Maintenance Battalion. A Company, 50th Signal Battalion, and the 28th Combat Support Hospital completed the task force package.

The primary military construction project was a 4,200-foot, C-130-capable airstrip, along with a taxiway, parking apron, cargo staging area, and a fuel storage area. The strip was built near the city of Choluteca, about 17 kilometers from Nicaragua. Additional exercise-related construction (ERC)

An aerial view of the Choluteca strip. The strip's single surface treatment is complete through stage 30. The Pan American Highway is just to the left of the field.

By Captain William E. Rapp



projects included lime stabilization repair of the San Lorenzo taxiway, the construction of an 18-pad CH-47 heliport, and fuel and cargo staging areas near the port of San Lorenzo.

Nation-assistance projects included the construction of four concrete masonry unit (CMU) buildings in four different villages. Three of these would serve as school buildings, and one as a town hall. The task force also dug seven new wells at sites selected by the Honduran government. A small group of Air Force Reserve engineers, working with the task force, also built two additional buildings in Choluteca.

The Choluteca FLS

The Choluteca forward landing strip (FLS) was constructed as a 4,200-foot, compacted aggregate airstrip. The task force used a nonwoven geotextile fabric (8NP) over the subgrade, a 9-inch compacted lift of 3 inches (-), a 6-inch compacted lift of 3/4 inch (-), and a single surface treatment. The geotextile saved an estimated 14,000 cubic yards (CY) of aggregate.

Two sets of triple 36-inch culverts aided drainage under the taxiway crossovers. The soldiers used Reno mattresses filled with 3-inch (-) aggregate in the drainage ditches to control erosion during the rainy season. Construction was done with small, airborne engineer equipment, D-5B dozers, CAT 621 graders, and CAT 613B scrapers and water distributors.

Following construction of a gravel civilian bypass road around the strip, the battalion built

Top left: The villagers of Santa Maria gather around their new school building built by the 27th Engineers.

Left: The unit began their deployment with an airborne operation. Here, a small emplacement excavator (SEE) lands on the El Espino drop zone.

the cargo staging area and the fuel storage area. The asphalt section from Alpha Company placed MC-70 as a prime coat over the FLS, and then sprayed RC-250, followed by the spreading and rolling of 3/8-inch aggregate (washed) to complete the single surface treatment. The region's high temperatures (over 100 degrees Fahrenheit every day), retarded the curing process, but careful traffic control gave the treatment a chance to cure properly.

San Lorenzo Stabilization

The San Lorenzo taxiway, constructed the previous year adjacent to the San Lorenzo FLS, was showing signs of premature failure. Examination by the engineers of the Waterways Experiment Station (WES) at Vicksburg, Mississippi, indicated that the taxiway needed significant lime stabilization repair.

Bravo Company began the mission by removing 18 inches of stabilized topsoil from the affected areas, and bringing in new soil. Using one BOMAG recycler, BOMAG vibe roller, and two water distributors, the company re-stabilized the taxiway using dry lime instead of the lime-slurry method. The dry lime method required spreading the lime above the new topsoil in precise quantities. The recycler was then used to mix the lime, soil and water at an even rate. The vibe roller brought the resulting soil mixture to compaction standards in 10-12 passes.

El Caimito Heliport

Eighteen 25-foot by 50-foot concrete pads were used to construct the CH-47 heliport near the town of El Caimito. A supporting road network and fuel berms were also part of this project.

CMU Buildings

Although wooden buildings were originally planned for the battalion's nation assistance work, the task force was notified enroute to Honduras that CMU construction must be used. The greater life expectancy of the CMU design was given as the reason.

On arrival, the task force purchased the required materials locally, and the engineers adapted and improvised when faced with wide variations in material quality. The concrete mobiles again did yeoman service by placing the concrete pads for the buildings at very remote sites.

The task force constructed four CMU buildings: one each in Orocuina, Tierra Blanca, Santa Maria, and El Pillado.

Wells

During the dry season in southern Honduras, the availability of potable water becomes a critical factor in the health of villagers. Poor quality water often leads to serious health problems for people with no alternate water sources.

The 38th and 865th Well Drilling Detachments dug seven wells for the Hondurans. The units used the new 600-foot drilling rig, and installed hand pumps on the wells they left the villagers. Pea gravel, necessary for development of the wells, forced combat engineers to improvise. Several cubic yards of the critical material was obtained by screening river gravel by hand.

Lessons Learned

Once in country, obtaining missing critical equipment is very difficult and/or extremely expensive. Forethought prior to deployment brings to mind Roger's standing order to his rangers in 1759: "Don't forget nothin'."

The following points are critical:

- ▶ Plan for significantly more compaction equipment than expected. This equipment is always critical during the haul/spread/compact phase, and even rollers break down.
- ▶ Dry environments require vast water distribution capability. Lack of sufficient water results in poor compaction.
- ▶ Lack of adequate spare parts for low-densit equipment can be a show-stopper. Enginee equipment doing hard work—even with co scientious maintenance—will eventually brea down. And the lack of needed parts will kee it down.

Construction deployments to Latin America continue to offer significant challenges and rewards for engineers. A tough environment, demanding mission assignments, and the difficulties inherent in being so far from home base all add up to tougher, better training for soldiers. And Honduras offers some of the best.

Captain Rapp is the assistant S-3 for the 27th Engin Battalion. He previously served with the 16th Engin Battalion, and the 1-1 Cavalry Squadron. He is graduate of the Engineer Officers Advanced Course. received his degree from the U.S. Military Academy.

District Project Engineer:

The Road Less Travelled

The "road less travelled" is often touted to be the most rewarding. For junior engineer officers, that road is often an assignment as a project engineer for a U.S. Army Corps of Engineers district.

Alaska & John Nelson

There are many choices available to officers who have successfully completed company command. Most would like to continue in a troop assignment, but often this is simply not possible. Some officers don't realize the professional development that a district assignment can offer. Many others often don't know that the assignment even exists. But it is well worth investigation. For an engineer officer interested in furthering his career, particularly in construction management, I think there is no better opportunity than working in an engineer district.

The Corps is the largest engineering and contracting agency in the free world. It regulates the nation's navigable waters and wetlands, and handles real estate functions for most Army and Air Force installations throughout the world.

Each district office is normally commanded by a colonel and staffed primarily with civilian employees—along with several military engineers. The primary mission of a Corps district office is to plan, design and monitor construction projects.

For officers interested in such an assignment, a degree in engineering is often preferred, but is not mandatory. What really counts is managerial skill. The ability to gather accurate information quickly, deal with all types of people, and make sound decisions are the keys to success in a district job.

My four-year tour with the Alaska district ended last summer, bringing to a close one of the most challenging and rewarding experiences of my career. I first served as the assistant resident engineer, and then moved to the position of assistant to the chief of the regulatory branch.

As assistant resident engineer of the Richardson office, I was responsible for about 20 projects with a contract value of $138 million. This is a position that a captain could typically expect to receive for at least one year of his tour with a district. And this is where the rubber meets the road. The project officer works directly with contractors to ensure a quality finished product that's on schedule and within budget.

To be able to do that requires on-site visits to the contract sites, and extensive travel is an integral part of the project engineer's life. In the case of the Richardson office, these contract sites are spread over a vast area, reaching from the tip of the Aleutian Islands, to Haines in the southeast, and Galena in the north.

In fact, the first contract negotiation I handled was located near Cold Bay, in the Aleutian Islands. It wasn't the most difficult or costly negotiation I was to have, but it served to drive home the sometimes emotional aspect of my duties.

In March 1985, I had been in my job for two months when the claim was presented. A contractor working near Cold Bay had to stop

By Major John Nelson and Captain Donald R. Curtis, Jr.

John Nelson, right, confers with other engineers during a project site visit at Prudhoe Bay, Alaska. From left are Bob Oja, Lieutenant Colonel Roy Carlson, and Colonel William Kakel, district engineer for the Alaska region.

work for more than a month because of frozen ground conditions. He claimed that relic ice (a permanent frost condition) was present in the site he was contracted to excavate, and asked that he be compensated for a $90,000 loss for work stoppage.

The case required some research on my part, and the district's geology department assisted me in this effort. A primary factor in my decision was that the ground in the Aleutians rarely develops a deep, penetrating frost. The temperature range is between 5 and 55 degrees Fahrenheit, with a typical average winter temperature near the freezing mark.

The winter of 1984-1985, however, was unusually cold. The months of January and February in particular were far below normal, with temperatures never rising above freezing. The contractor failed to anticipate the possibility of significant frost problems, and did not bring adequate equipment for the job. He was faced with the decision to fly in a larger dozer, or wait and hope for a quick thaw. Unfortunately, he chose to wait.

My final decision was in favor of the government, since the frozen ground encountered by the contractor was not relic ice, and the government is not responsible for the normal forces of nature. The decision was upheld on the contractor's appeal to the district engineer.

It was not an easy decision to make. The contractor endured a significant time delay because of an ice condition that he had no control over. It wasn't a very big company, and the loss of revenue hurt. While it could be argued that he should have planned the job better, all of us know that it is impossible—or sometimes too expensive—to try and be prepared for all contingencies. This case, like many others to follow, tested my knowledge, judgement, and emotions. But the job made me a better engineer and contributed significantly to my professional development as an officer.

Officers will normally rotate through two or three different jobs while serving a district tour. A variety of jobs are open to junior military officers in planning, design, safety, environmental or regulatory branches of a district operation.

After a year as a project engineer, I spent the remainder of my tour in the district's regulato
branch. This branch regulates th
use and development of navigab
waters and most wetlands withi
its jurisdiction. The office receiv
permit applications seeking use
certain land or waters fro
private citizens or companies.
then evaluates them in coordin
tion with other local, state ar
federal agencies, and makes
determination on whether or n
to issue a permit to the applican
Unfortunately, the final decision
not always well received.

A case in point was the applic
tion for construction of causewa
in the Beaufort Sea to suppo
Niakuk oil field development.
prime factor we had to consid
from the Corps' point of view w
the effect the causeways wou
have on wildlife. Two causewa
that had been constructed earli
were already causing a distu
bance of fish migration habits.

Based on years of study
fish migration in the area,
decision was made to deny perm
sion for the additional causeway
variety of experts believed th
the extra causeway would de
the fish from migrating to th
spawning grounds, and threat
their existence as a species. T

Top: Don Curtis, center, checks the progress of work on the new Engineer School facilities at Fort Leonard Wood.

Bottom: An aerial view of the same site. Junior officers often get to oversee such construction as part of their project officer duties in a Corps district.

fact-gathering in the case was done by our regulatory branch, which contracted studies on the subject by private organizations. Studies conducted by environmental organizations were also considered in making the final decision.

The oil companies did not agree, but the decision held. The risk to the fish migration was considered too great when compared with the expected benefit of the causeway.

My last district mission came when the Exxon Valdez ran aground in March 1989. The Alaska district set up a 24-hour emergency operations center and became an integral part of the clean-up effort. The Corps dredges Essayons and Yaquina were brought in to aid the clean up, and were controlled by the Alaska district. During the first months of the operation, I was a briefer and guide for Corps personnel assigned to assist in the effort. With a lot of hard work on the part of both the Corps' military and civilian personnel, the Army's effort made a real contribution to recovering spilled oil.

I wouldn't hesitate to recommend a district tour of duty to a junior officer. The challenges are great, and the job will demand all of your technical expertise and managerial skills. But the rewards are just as great. You will grow both as an engineer and as an officer. And that means you'll be better equipped when the time comes later in your career for a battalion XO or command slot.

Missouri & Don Curtis

My assignment as an assistant resident engineer for the Fort Leonard Wood Resident Office of the Kansas City district offered me challenges and opportunities that I could not have found anywhere else.

I was fortunate enough to be able to tackle the challenge of ensuring the timely delivery of the new Engineer School facilities to the Army. It was the opportunity of a lifetime to oversee a $42 million construction program, and a little nerve-wracking at times making sure that the Engineer School's critical need dates were met.

There were daily chances for professional growth. Graduate school study was put to good use, particularly in the areas of network analysis and construction scheduling. For example, toward the end of the project, there were five contractors attempting to work in the same building, and many scheduling conflicts had to be resolved every day.

The Kansas City district took the lead in compiling a master critical path method (CPM) schedule to keep everyone working to complete the job on time. The plan worked, and the new Engineer School headquarters, academic facility, and unaccompanied officers' quarters were ready in time for the start of the first scheduled classes.

Daily problem solving during the project was routine. To help with my contract administration responsibilities, I was fortunate in being able to attend several proponent-sponsored engineer corps training (PROSPECT) courses. These covered subjects like contract negotiations, duties of the contracting officer's representative, and the district officer's introduction to contracting. All the courses are designed to provide officers with the basic skills needed for jobs like mine—but they'll also be of value later in my career. I've found that the Corps makes a considerable investment in training its people, and officers assigned to a district job can expect to regularly upgrade their professional knowledge.

Another benefit of serving in a district is the chance to serve with a largely civilian workforce. These are a cohesive, technically proficient group of people, dedicated to serving both the military and civil populations. Working with resident engineers, who routinely manage hundreds of millions of dollars in high-visibility construction contracts, has provided me with important lessons in leadership and management.

In addition to the Engineer School facilities, I've had the chance to administer contracts for the Defense Mapping Agency Aerospace Center and the Harry S. Truman Dam. These projects included new construction, maintenance and repair, and toxic and hazardous waste cleanup.

An officer serving in a district can expect a fulfilling job that will expand his professional abilities, and prepare him well for later career assignments. For someone with an engineering background, a district assignment is one of the most rewarding opportunities to be found anywhere.

Major Nelson is executive officer of the 577th Engineer Battalion. He previously served as chief of the Roads and Airfields Branch of the Engineer School's Department of Military Engineering. In addition to his Alaska tour of duty, other assignments included engineer advisor for Readiness Group, St. Louis; company commander for the 937th Engineer Group, and senior instructor for the Engineer School. He holds a degree in business management from the University of Southern Colorado.

Captain Curtis is currently attending Command and General Staff College. He previously served as assistant resident engineer for the Fort Leonard Wood Resident Office, Kansas City District. He previously served as a company commander with the 44th Engineer Battalion, and platoon leader with the 902d Engineer Company. He is a West Point Graduate, and holds a masters degree in civil engineering from Ohio State University.

(Personal Viewpoint continued)

employment of engineering pri
ciples. A well known sports ada
states that "you play the way yo
practice." If we are going to fight i
a joint arena, then certainly joi
training exercises will help
prepare for that end.

A recent visit to Fort Leona
Wood by Colonel J. A. Marapo
Commanding Officer of th
Marine Corps Engineer Scho
helped to rekindle the spirit
sharing our concerns, issues, a
experiences. Both sides agre
that the exchange of informatio
ideas, and lessons learned mu
continue, and the groundwork w
laid for future visits.

Let us continue the momentu
Whether you are a commander,
staff officer, or a trainer, you are
a position to influence future e
gineering excellence. Because t
Marine Corps places special e
phasis on small unit leadersh
junior officers and especially no
commissioned officers (NCOs)
come the focal point for training.
most cases, NCOs are the trainer

Staff NCOs (E-6 through E
also play a critical role as instr
tors at the Marine Corps Engine
School. Therefore, it is of utm
importance that these educators,
well as their Army counterpar
remain involved and up-to-date
all current doctrine, equipme
and training innovations.

I submit that we must all ta
advantage of the opportunity th
lies before us by ensuring int
service coordination of engine
matters at every level. I challen
all engineers to make a comm
ment to the concept that will bri
success—TEAMWORK.

*LtCol Drury is assigned as
Marine Corps representative to
Army Engineer School and Co
manding Officer, Marine Deta
ment, Fort Leonard Wood. He
previously assigned as the Co
manding Officer, 9th Engineer S
port Battalion, 3rd Force Ser
Support Group, Fleet Marine Fo
Okinawa, Japan.*

Engineer Solution

Step 1. ***Analyze the relative combat power.*** Analysis of relative combat power is based on the situation template and an engineer battlefield assessment of enemy and friendly mobility/countermobility/survivability (M/CM/S) capabilities.

- *Enemy M/CM/S capability:* The area between PL Red and PL Blue will have extensive tactical and protective obstacles, most of which will be minefields. Because this area was a main defensive belt, there may be a combination of buried and surface-laid mines, with some having anti-handling devices. Most minefields near PL Red will contain anti-tank mines, while those near PL Blue will be mixed or anti-personnel mines.

The brigade and task force S-2 believe that the lead MRB(+) is the advance guard of a motorized rifle regiment (MRR). The MRB(+) will be organized for a meeting engagement with a CRP, FSE, and advance guard main body. The enemy MRR can rapidly emplace mines to protect its flanks.

Based on its doctrine, the MRR will organize a mobile obstacle detachment (POZ), which will travel in or behind the vanguard. The POZ may be deployed to protect the flank of the advance guard's main body as it maneuvers to attack our flank after the FSE is deployed. You and the S2 configure the enemy's offensive use of minefields, as shown on the Situation Template (page 19).

- *Friendly M/CM/S capability:* For this problem, assessment of friendly capability focuses on the mobility assets available. TF Tank's mobility assets, based on its task organization and mobility assets organic to CO A/52d EN BN, include—

TF MOBILITY ASSETS (ORGANIC)

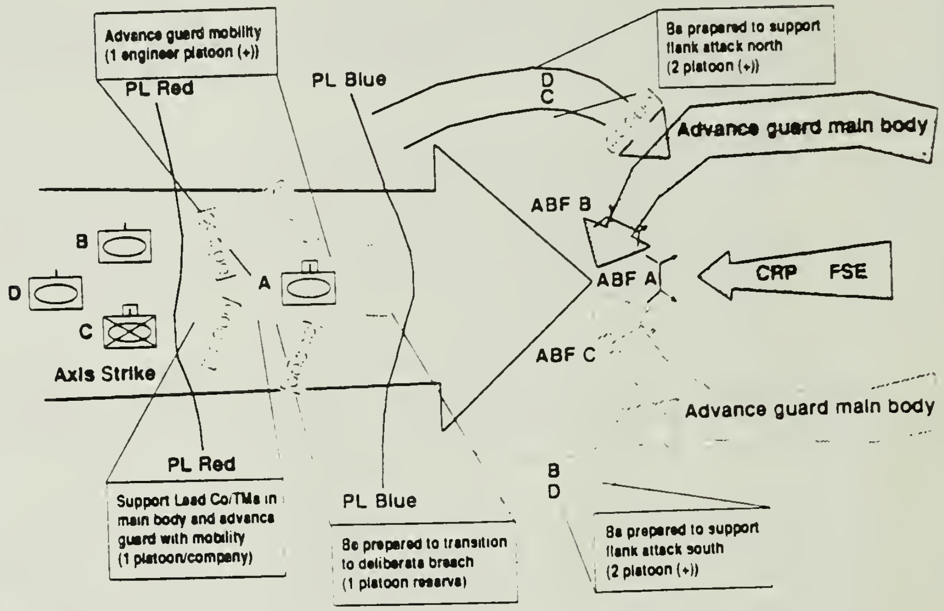
3 Mine rollers
9 Mine plows
3 Infantry platoons

A/52d EN BN MOBILITY ASSETS

9 Sapper squads
6 M9 ACEs
2 CEVs
4 MICLICs
4 AVLBs

Step 2. ***Identify missions and allocate forces:*** In this step, use the reverse planning process to identify M/CM/S tasks, working from the objective back to the line of departure (LD). Each time a M/CM/S task is identified, allocate the force needed to accomplish it. Do not constrain the forces allocated to each task by the assets in your task organization.

Engineer Solution


Advance guard mobility (1 engineer platoon (+))
PL Red
PL Blue
D
C
Be prepared to support flank attack north (2 platoon (+))
Advance guard main body
ABF B
B
D
A
C
ABF A
CRP FSE
ABF C
Axis Strike
Advance guard main body
PL Red
Support Lead Co/TMs in main body and advance guard with mobility (1 platoon/company)
PL Blue
Be prepared to transition to deliberate breach (1 platoon reserve)
B
D
Be prepared to support flank attack south (2 platoon (+))

Engineer Working Overlay

A good technique is to write each task and force allocation on your copy of the course of action sketch or Task Force Operations Overlay, page 19. They will show the M/CM/S tasks and force allocations required for each mission in the battlefield placement. This overlay will be used to develop the engineer task organization and scheme of engineer operations, as shown in the Engineer Working Overlay, above. Note that some, if not all, of the M/CM/S tasks were identified during the mission analysis phase of the engineer estimate.

Step 3. *Develop a scheme of engineer operations:* The goal of this step is to integrate force allocation, execution of engineer tasks, and engineer priorities into the scheme of maneuver and task organization. The scheme of engineer operations is developed by working the maneuver plan from LD through ABF ZULU to consolidation. As you "wargame" the maneuver plan, note the engineer tasks that must be accomplished and the forces required. Task organize these forces to the appropriate maneuver subunit. In some cases the task may be accomplished better under task force or engineer company control.

As assets become scarce, determine where mobility assets can reasonably be expected to accomplish several tasks. Do not omit mobility assets that are

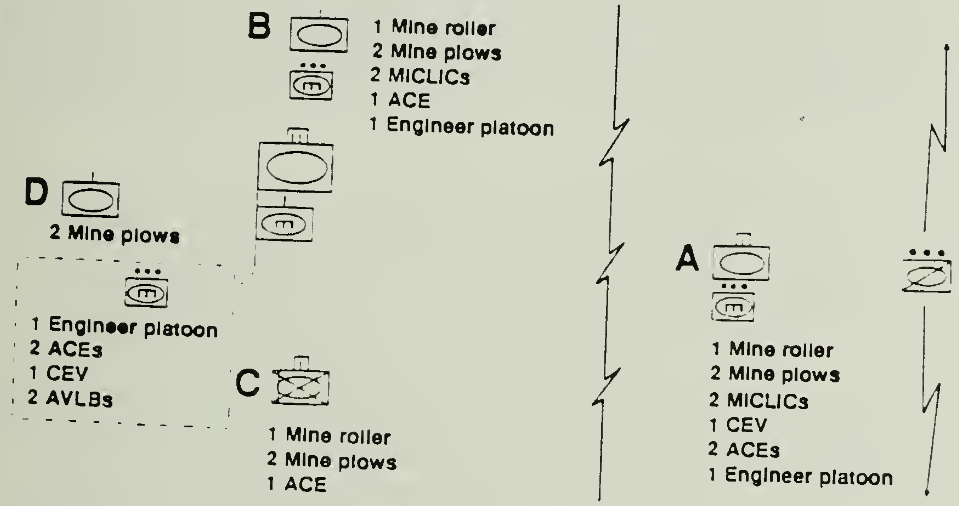
Engineer Solution

organic to the maneuver unit; remember, you are the TF engineer not just the engineer company commander.

And, as you allocate mobility forces, remember that the maneuver commander's intent is to organize his force for an in-stride breach. Refer to the In-Stride Breach Description, on page 20.

Possible Scheme Of Engineer Operations Solutions

The task force will cross the LD organized for an in-stride breach, with mobility assets attached to the advance guard (Team A) and in the main body (Company B and Team C). A mobility reserve will initially remain under task force control and move center of the task force (-) VEE, as shown below in the Task Force Formation.



Task Force Formation

The engineers' initial main effort is to provide Team A with mobility through enemy obstacles from PL Red to PL Blue. The mobility reserve will be prepared to support Team A or Company D. If transition to a deliberate breach is necessary, the mobility reserve will shift to Team C as the TF breach force. In this scenario, Company B will become the support force and Company D the assault force.

Engineer Solution

After Team A makes contact with enemy CRP and FSE, priority of engineer effort shifts to passing the main body through Team A's breaches. Team A engineers assist in the passage. On order, the mobility reserve shifts to Company D, and the engineers' main effort shifts to supporting the flank attack on the enemy's advance guard and breaching POZ flank obstacles. The allocation of mobility assets is shown in the Task Force Formation, page 31.

Some major considerations that should become apparent as you develop a scheme of engineer operations, working from LD to destruction of the enemy in ABF ZULU, include:

Supporting the scouts. A critical task in any movement to contact is to develop the situation. This includes the identification of enemy obstacles. Early detection of enemy obstacles in the old enemy defense area helps to ensure force mobility. Also, enemy obstacle activities identified during the meeting engagement may indicate the enemy's intentions.

Normally engineer forces augment the scouts with an engineer sapper squad to assist in the reconnaissance effort. In this problem, the scouts are screening in front of the advance guard as it attacks on Axis Strike. This allows too little time for an engineer squad to close with the obstacle and provide information quickly to follow-on forces. Therefore, an engineer squad will be of no help. The scouts need to:

- Report any obstacles they encounter
- Be equipped to extricate themselves from a minefield
- Be equipped to mark all obstacles encountered and any lanes or bypasses they find or create.

Supporting the advance guard. The success of a movement to contact initially depends on the advance guard's ability to develop a situation so that the main body can act decisively. Thus, the advance guard must maintain freedom to maneuver and control the support, breach, and assault forces. They must have the ability to conduct numerous breaches against diverse obstacle types. Maintaining the advance guard's mobility from PL Red to PL Blue is the engineer company's main effort and primary task.

Supporting the main body PL RED to PL BLUE. Because the task force (-) is attacking in a VEE formation, Company B and Team C must maintain control of mobility assets so they can conduct company- or team-level breaches (TF in-stride). Only light contact is expected from PL Red to PL Blue.

Engineer Solution

and both Company B and Team C have adequate forces to effectively suppress and secure during a breach. By providing both of them with mobility assets under company/team control, the main body is organized for a TF in-stride breach. This allows the main body to breach obstacles with minimum TF-level maneuver, command, and control.

Company B and Team C are organized with mobility assets based on their organic mobility weaknesses. Company B is tank pure and needs dismounted breach capability; he is allocated an engineer platoon. Team C, which has no means of mechanical breach or detection, is allocated mine rollers, plows, and ACEs. Team C is not given an engineer platoon and must rely on its own infantry for dismounted breach capability. An engineer platoon (+) maintained under TF control allows mobility assets to be shifted and massed in a breach force if a deliberate breach becomes necessary. The mobility reserve will shift to support Company D if necessary.

Supporting actions on contact/actions on ABF ZULU. Based on the maneuver plan, Team A's mission is to destroy the enemy's CRP and FSE. Thus, M/CM/S support requirements become minimal and are no longer the engineers' main effort. Deployment of the main body depends on the direction of attack by the enemy's advance guard. Rapid maneuver of the TF main body becomes the main effort, and engineers with Team A assist in passing the main body through Team A's breaches.

If the advance guard attacks from the north, Company B will establish an attack by fire (ABF) position echelon left of Team A to fix the enemy's advance. Team C and Company D will attack by fire and maneuver around to the north and into the flank of the enemy advance guard's main body. The engineers' main effort will shift to massing mobility assets with Team C and Company D to breach any flank obstacles emplaced by the POZ.

If the enemy attacks from the south, priority shifts to Company B's and Company D's attack by fire and maneuver, while Team C anchors off Team A's right flank. In either case, the mobility reserve will shift to support Company D. Engineers with Company B and Team C must be prepared to shift to the flanking maneuver.

This Engineer Problem was submitted by Captain Watson, currently serving in Saudi Arabia. He was an instructor/writer at the U.S. Army Engineer School, Department of Combined Arms, at Fort Leoanrd Wood. He is a graduate of the U.S. Military Academy and the Infantry Advance Course, and has served as an observer/controller at the National Training Center.

CADD Makes Its Mark

In the military, the phrase "do more with less" has become as common as it is unwelcome. But often, the drive for economy and efficiency can lead to decisions whose value goes far beyond mere dollar signs.

The Army's implementation of the Computer Aided Drafting and Design (CADD) system is an example of one of those decisions. A boon to productivity, the system allows faster design and modification of drawings for engineering, architecture, facility management, and allied disciplines. Users can produce quality drawings up to four times faster than manual drafting.

While the system has received only limited distribution to the field so far, it has proven so effective that CADD units have been sent to Saudi Arabia for use during Operation Desert Shield. Draftsmen (81B) and construction officers in combat heavy battalions have been targeted as the primary users.

The CADD hardware package consists of a 386 personal computer with a math co-processor, a multicolor plotter, high-resolution monitor, and a digitizer tablet.

A primary feature of CADD is the access it gives to computer-stored information. The system is designed to access digitized Army Facilities Component System (AFCS) catalogs. These catalogs contain more than 4,000 drawings of buildings and other facilities deemed critical to military operations.

In addition to allowing greater speed in producing new facility plans, CADD gives users the ability to modify existing drawings, like those in AFCS, to meet the specific needs of their engineering projects. The system will also import other data from the theater construction management system (TCMS) database, site survey data generated by the automatic integrated survey instrument (AISI), and standard symbols libraries. Drawings and other data generated by users will be exported back to the TCMS database for use by other CADD operators.

CADD has other features designed to speed the facilities engineering process. With its multicolor plotter, a user can show several systems, i.e., plumbing, electrical, and communications, on the same drawin This often makes it easier to convey the designer's concept and intentions for the facility.

The development of a bill of materials (BOM) and cost estimates will also be easier with CADD. For example, if an engineer has an existing 30 x 50 foot building and needs to add a 30 x 20 foot room, the additional cost and BOM can be computed automatically after material prices have been entered into th database. CADD can give a line-by-line description materials needed for the extra space, the quantity of materials needed for the structure, and both the item and total costs of the project.

Standardization has been carefully planned into the Army's CADD program. As engineering-related fields, both military and civilian, adapt to the CADD technology, the Army Corps of Engineers continues to be an important participant in several CADD standardization boards.

One of these is the Task Force on CADD Layer Guidelines, organized in September 1988. Four professional associations and three government age cies participated:

The American Institute of Architects

The American Consulting Engineers Council

The International Facility Management Associati

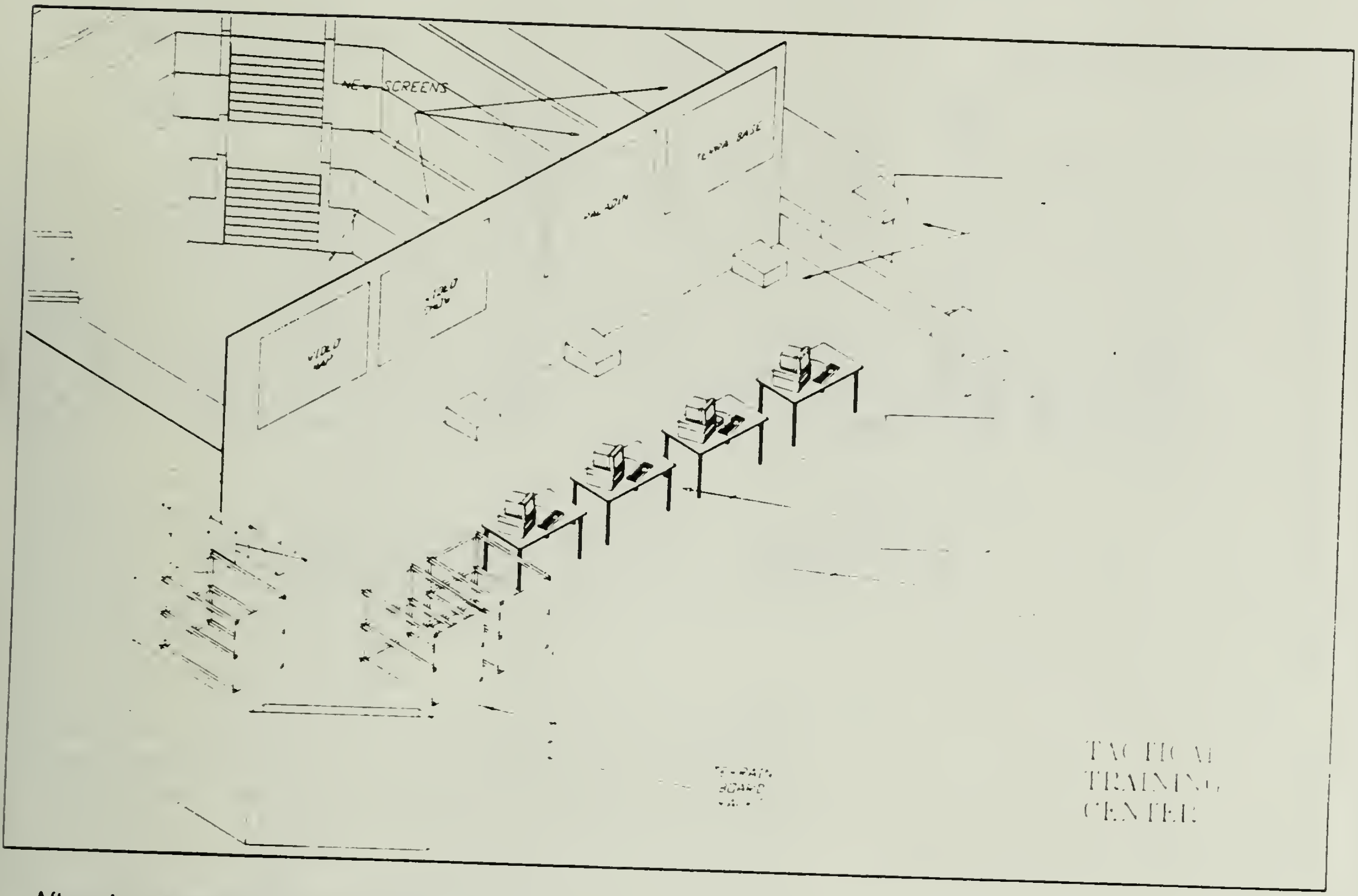
The American Society of Civil Engineers

The U.S. Army Corps of Engineers

The Naval Facility Engineering Command (NAVFAC)

The Department of Veteran Affairs

By Rick Seams and Ron Wenrich



An original facilities drawing made with the CADD system, like this tactical training center, can be easily modified for other building projects. Tapping into the Army Facilities Component System (AFCS), CADD users also have access to more than 4,000 additional military-related drawings.

After almost two years of work, these organizations recently completed release 1.0 of the CADD Layer Guidelines. The completion of these initial guidelines represents a significant step in providing all engineer-related groups with shared graphic information through a computer-aided design program.

And the CADD train is moving fast. Drawings and design information that used to be available in TM 5-302, *Construction in the Theater of Operations*, and in the Navy/Marine Corps Facility Manual (NAVMC), have already been converted to the CADD format and will be available only on floppy disk. This will require engineers to have the CADD capability to use existing drawings for theater of operations construction.

The old design tools for facilities engineering are fading fast. While there will always be a place for the "stubby pencil," CADD is the future for improved productivity and quality.

Mr. Seams is chief of the Technical Engineering Branch of the Department of Military Engineering at the Engineer School.

Mr. Wenrich is a training specialist and acting course chief for the 81B technical drafting specialist course, 87th Engineer Battalion, Fort Leonard Wood.

Building to Last in the Tropics

By Captain Kevin S. Porter

Most Army engineers don't get the opportunity to undertake construction projects in tropical environments. And if they do, their personal experience and "how-to" manuals often don't cover the special construction problems they face.

A vertical construction team from B Company, 84th Engineer Battalion, faced just such a challenge recently when they deployed to Mirpur, Bangladesh, to build three school buildings for the town. Their experiences with the area's extreme weather, the project's shortage of materials and equipment, and their ability to overcome those conditions should be added to the notebooks of fellow engineers.

Materials

Each of the school buildings was to be 26 feet by 60 feet, and the choice of materials used for their construction was critical.

Brick is the most plentiful and frequently used building material in the country, and was considered for the school buildings. However, the local bricks are not durable enough to withstand the violent storms of the monsoon season an
the accompanying heavy floods. A
existing school near the constru
tion site was destroyed by a storm
during the engineers' deployment.

Wooden construction was ruled ou
because lumber is prohibitively e
pensive in Bangladesh, which ha
been largely deforested. Too, u
treated wood would have been su
ceptible to termites and other woo
damaging insects in the region.

Concrete was eventuall
selected as the building materia
though this created its own set
difficulties. For instance, th
country is situated on a huge riv
delta, and the land is mostly si
The aggregate necessary f
making concrete is not available

Fortunately, the abunda
supply of bricks gave the e
gineers a solution: break th
bricks into small chips as a su
stitute aggregate.

Equipment was another hur
for the 84th engineers. A platoo
Bangladesh Army engineers h
been assigned to work with
Americans, but they did not h
access to a large selection
equipment. No concrete tru
were available, so all concrete

to be prepared in a small mixer.

Precast Concrete

The lack of sufficient mixing capacity made large concrete placements impossible, and led to a decision to construct the buildings from precast concrete slabs. The buildings' beams, columns, trusses and roof slabs were also made of precast concrete. The slabs were designed to allow placement by hand, and the roof slabs and trusses were lifted into place with a Chinese-made crane.

The project marked the first time that such a construction technique was used in Bangladesh, and allowed the engineers to complete the buildings with a minimum amount of equipment. The crane, cement mixer, a Vietnam-era road grader, and a military surplus loader on a 2-day loan from a civilian contractor were the only pieces of equipment used for construction.

Defects

Use of the precast concrete technique posed some difficulties for the local contractor hired to make the prefabricated members. Although he was provided design specifications by the engineers, he had no experience in making the required parts.

Because the quality of the precast concrete was questionable, the engineers decided to load test all of the parts before using them in construction. As it turned out, the concrete purlins that supported the roof slabs failed below their designed strength, with quality control appearing to be the culprit.

To save time and money, the engineers opted to reinforce the purlins instead of having them recast. Two days later, after being reinforced with steel plates, the purlins passed the load test.

Concrete = Money

The cost of locally procured materials was a significant factor in construction of the buildings. While durable in the long run, concrete was also extremely expensive in Bangladesh. Because funds available for the project were limited, every effort was made to reduce the amount of concrete used, while maintaining safety and quality. For example, the amount of concrete needed for the floor slab was reduced by using the ever-present Bangladesh bricks. They were used as a subbase for the slab, and then a four-inch-thick layer of concrete was placed over the bricks. This provided a stable base, while saving much cement and money.

The crushed-brick aggregate had a tendency to "float" in the floor slab cement, and it was impossible to get a good surface finish. The solution was to leave the floor rough, and then finish it

American and Bangladesh engineers push their small cement mixer to the school construction site. Lack of equipment made manual labor one of the primary means of construction for the project.

Roof slabs for one of the buildings are lifted into place with th crane. A pile of the ever-presen Bangladesh bricks is on the right.

with a thin, cement-rich mortar. While not possible in climates with a freeze-thaw cycle that would crack the floor, this method works well in the tropics.

And...

The climate of the country was a constant hinderance, with temperatures routinely exceeding 100 degrees Fahrenheit. The heat was so bad that water evaporated from concrete before hydration was complete. This required a considerable number of manhours just to move water bucket-by-bucket to wet new concrete.

The final challenge to the Bangladesh deployment was culture. Language was not a significant barrier because the Bangladesh platoon leader spoke fluent English. However, during the project, his Moslem soldiers observed a religious fast called Ramadan. This limited most of the Bangladesh engineer platoon to one meal a day, at 8 p.m. In addition, the soldiers could not drink water during the day, which greatly affected their productivity and slowed construction progress. This problem had not been foreseen, and all engineers engaging in such projects should research local customs and religions to determine their potential impact on construction schedules.

Despite a few out-of-the-ordinary complications, the mission was completed in 45 days and was considered a success by everyone involved. The project gave the engineers training and experience they couldn't have gotten anywhere else, Bangladesh and American engineers built a new working relationship, and the local community received three new buildings.

The real winners though, were the school children of Mirpur. Safe in their storm-resistant school buildings, they are sure to remember the American engineers for years to come.

Captain Porter is the civil engineer for the 84th Engineer Battalion. He previously served as a company commander with the 84th, and a platoon leader and executive officer with the 43rd Engineer Company. He is a graduate of West Point, and the Engineer Officers Advanced Course.

MOBNET

and Army Mobilization Planning

By Terry Atkinson

Just before Iraq swallowed Kuwait, the world was fairly awash with optimism. Democratic and free-market principles had breached the Iron Curtain. Bloody clashes in Afghanistan and Nicaragua had faded away. Iran and Iraq were both licking their wounds at the end of a years-long war. It seemed as though a contagious peace virus had been loosed on the planet.

Amidst that kind of euphoria, and strong talk of how to spend the "peace dividend," the call for comprehensive war planning—much less mobilization—tends to fall on deaf ears.

But then we were called upon to mobilize forces for deployment to Saudi Arabia, and prepare ourselves for battle with the Iraqi military. Less than a year ago, most people would have dismissed the possibility of such a confrontation.

New questions are being asked about the best way to handle large-scale mobilization of American forces, and the Army's mobilization network (MOBNET) system may be one of the answers.

Originally designed by the U.S. Army Engineer Studies Center for mobilization and industrial base planners, MOBNET is a potential cornerstone for virtually all Army planning. It links a variety of decision-support systems, allowing the collection and sharing of critical data. The system is designed to measure ammunition and major equipment requirements for extended combat, and can be expanded to include other supply needs and personnel requirements.

A Continuing Need

Since World War II, it can be argued that mobilization preparedness has not received its fair share of attention. Most planning emphasized requirements for wars lasting six months or less. When the Soviet Union was our prime adversary, we believed that a conventional war with that country and its Warsaw Pact allies, should it ever occur, would be short in duration. A quick progression to

> "...despite the apparently defused superpower confrontation, the United States must still contend with... other powerful military forces in today's world..."

COUNTRY	ARMED FORCES
Soviet Union	4.4 million
China	3.5
United States	2.3
India	1.5
Vietnam	1.3
Iraq	0.9
Turkey	0.9
North Korea	0.8
South Korea	0.6
Pakistan	0.6
France	0.6
Brazil	0.5
Italy	0.5
[West] Germany	0.5
Egypt	0.5
Poland	0.4
Syria	0.4
Taiwan	0.4
Iran	0.4
United Kingdom	0.3

Data taken from *World Military Expenditures and Arms Transfers, 1988* (U.S. Arms Control and Disarmament Agency, June 1989) page 3.

Figure 1

nuclear weapons was almost always a part of any planning scenario. In these circumstances, there was little need to answer questions like:

- How many units—and what types—will be needed in a prolonged conflict, once available Active and Reserve forces are committed?
- What new manufacturing and production capabilities will be needed to support such a conflict?

These are questions that are best asked—and answered—in advance. Transition from a peacetime to a wartime economy is a lengthy, complicated process. Such a transition demands a strong foundation of planning if it is to succeed with optimum economies in time and money—and maximum efficiency in materiel production and other support of a mobilization effort.

The simplistic cold war conflict between America and the Soviet Union tended to overshadow other threats to our security. But military power has seen steady growth in other parts of the world.

According to the U.S. Arms Control and Disarmament Agency, only eight of the 20 largest military forces are controlled by countries traditionally aligned with America or the Soviet Union (Figure 1). Only three of the top 10 countries are so aligned.

The arms export business is booming among nations outside the circle of the world's major suppliers like the United States, Soviet Union, France, and Great Britain. In 1977, developing nations held about 4 percent of the world's arms export business. By 1987, the figure had risen to 8 percent.

Today's arms traders among developing nations include China, Brazil, North Korea, Yugoslavia, Bulgaria, Israel, Chile and Argentina. The days when larger nations could dominate emerging ones by cutting off arms supplies are rapidly fading. Customers denied access to arms from major suppliers can turn to a variety of smaller, but eager, vendors.

High technology, too, is no longer limited to the exclusive superpower club. Two of the six nations which admit to possessing nuclear weapons, China and India, are considered developing nations. Speculation over other nations that may have an unannounced nuclear capability has raised the names of Israel, Argentina, Pakistan, Saudi Arabia, South Africa, and Syria. Iraq, as news reports have suggested, may be well on the way to a nuclear weapons capability.

So, despite the apparently defused superpower confrontation, the United States must still contend with the possibility of conflicts with other powerful militar forces in today's world. And suc conflicts can strain the resource of even the world's most powerfu nations.

MOBNET

MOBNET is a simple concept (Figure 2, page 41) There are four decision points 1.0 through 4.0. Each is tagge with a descriptive phrase whic characterizes the point's desire output. Each decision point a cepts data, manipulates it, an exports new data to othe decision points. The direction the data flow is portrayed by a rows, which are labelled to sho the specific information require by each receiving decision point.

Decision Point 1.0

The most critical step withi the MOBNET framewo is decision point 1.0, which ide tifies theater Army forces. Usi operations plans and comb simulations, the Army defin the forces required to execute i portion of the nation's strateg This decision point manipulat data to produce a list of comb combat support and combat s vice support units needed in combat theater. The units' tabl of organization and equipme (TOE) will define th structure.

The force list produced decision point 1.0 accounts only for the current Active a Reserve forces, but also any n forces which must be added order to ensure the Army's s cess. This force information is to developing wartime requi ments for the Army. The for deployed to a theater are not o

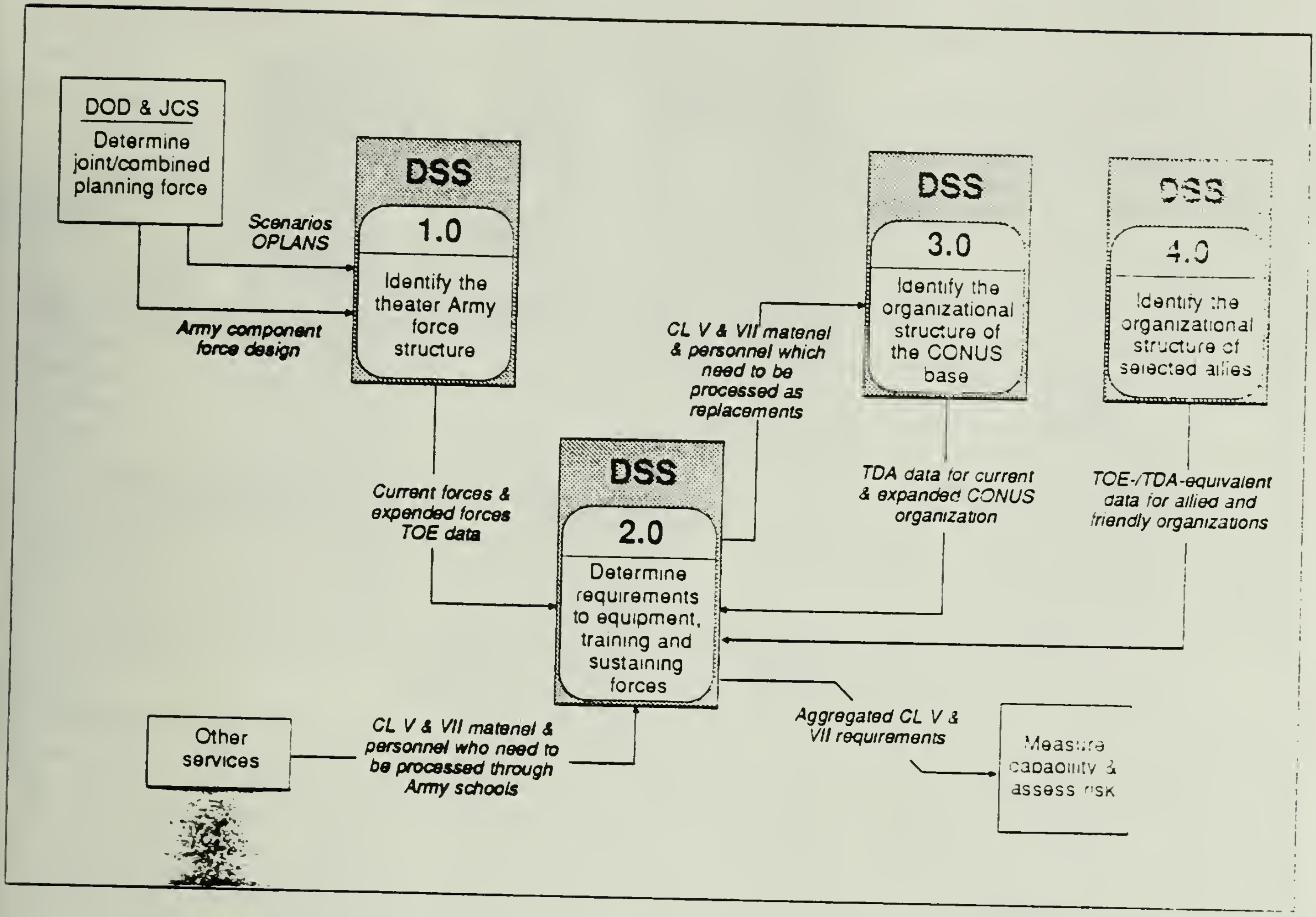

DOD & JCS
Determine joint/combined planning force
Scenarios OPLANS
Army component force design
DSS
1.0
Identify the theater Army force structure
Current forces & expended forces TOE data
CL V & VII materiel & personnel which need to be processed as replacements
DSS
2.0
Determine requirements to equipment, training and sustaining forces
DSS
3.0
Identify the organizational structure of the CONUS base
TDA data for current & expanded CONUS organization
DSS
4.0
Identify the organizational structure of selected allies
TOE-/TDA-equivalent data for allied and friendly organizations
Other services
CL V & VII materiel & personnel who need to be processed through Army schools
Aggregated CL V & VII requirements
Measure capability & assess risk

Figure 2

the greatest consumers of materiel—they directly affect the size and structure of the Army's support base in the continental United States (CONUS).

Decision Point 2.0

Decision Point 2.0 accepts TOE data for the theater forces. It converts the organizational data into specific equipment and ammunition requirements needed to equip, train and sustain all forces. It also accepts equivalent organizational data for Army units which remain in CONUS; allied formations supporting U.S. efforts, and the other military services. All of these groups represent potential claimants for Army-managed goods.

Decision Point 3.0

During a prolonged war, the support base in CONUS must provide resources for treating casualties, training replacements, transporting troops and materiel within CONUS, and performing administrative activities critical to the war effort. Should the plans require additional forces to bolster the Army's Active and Reserve units, then the CONUS support base must build and train new units from scratch.

Building and training new units may occur while the CONUS support base processes individual replacements for combat losses. This added activity may compel the enlargement of the CONUS base. Adding personnel and units places a greater burden on the support base: the new units and their staffs must be trained, equipped and sustained.

For example, as more trainees enter the system, the Army needs more trainers and training equipment. In turn, the need for more trainers stimulates the need to train more trainers. This iterative process is inferred from the two data arrows: one exiting decision point 3.0 and entering 2.0, and the other exiting 2.0 and entering 3.0.

Decision Point 4.0

Decision point [illegible] for the [illegible] selected allied [illegible] might claim. [illegible] certain allied nations and friendly foreign countries will be critical to the strategic goals of the

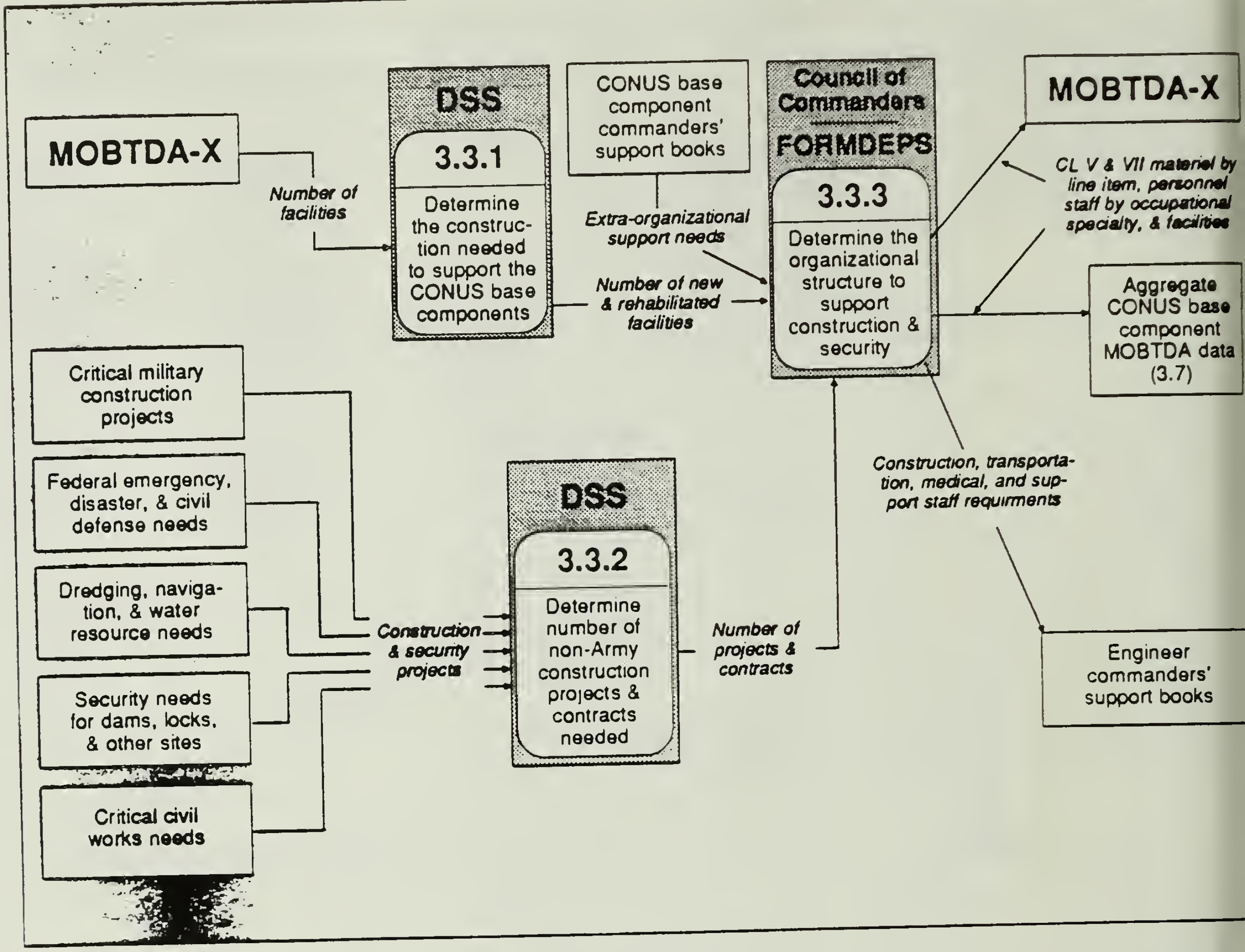

MOBTDA-X
Number of facilities
DSS
3.3.1
Determine the construction needed to support the CONUS base components
CONUS base component commanders' support books
Extra-organizational support needs
Number of new & rehabilitated facilities
Council of Commanders
FORMDEPS
3.3.3
Determine the organizational structure to support construction & security
MOBTDA-X
CL V & VII materiel by line item, personnel staff by occupational specialty, & facilities
Aggregate CONUS base component MOBTDA data (3.7)
Critical military construction projects
Federal emergency, disaster, & civil defense needs
Dredging, navigation, & water resource needs
Security needs for dams, locks, & other sites
Critical civil works needs
Construction & security projects
DSS
3.3.2
Determine number of non-Army construction projects & contracts needed
Number of projects & contracts
Construction, transportation, medical, and support staff requirments
Engineer commanders' support books

Figure 3

United States. A decision to support such groups with U.S.-produced materiel will compete with the needs of American military forces, and might also strain the nation's production capabilities.

Today's coalition planning calls for a policy of national responsibility, that is, the material needs of each coalition partner are the responsibility of that partner. Complete planning for mobilization requirements, however, demands that planners give credence to the possibility that non-U.S. forces will solicit American materiel assistance. Other services will also lay claim to Army-managed support (Figure 2, lower left). For example, the Army supplies the other services with artillery and small-arms ammunition produced at Army munitions plants.

Subordinate Decision Points

The Engineer Studies Center separated each of the four decision points shown into their underlying processes of data flows and decision points. In some cases, these subordinate decision points were broken down further into their component parts.

The Center produced no less than 13 schematics which define the MOBNET process in greater detail. Certain modules examine the process for identifying the theater force, and determini the requirements to equip a train all forces. Others exami the process for determining t structure of the CONUS supp base engineer, medical, tra portation, mobilization, traini and materiel procurement e ments. A final module amines the details of allied quirements.

The Engineer Module

The engineer component MOBNET is designed develop the personnel and eq ment needs of the staffs t form the Corps of Engineers tion of the CONUS support b Figure 3 shows the deci elements and data that must be considered.

Decision Point 3.3.1

Under mobilization conditions, the Corps is responsible for managing the construction needed to support CONUS-based organizations. Requirements for facilities such as barracks, classrooms, ranges, hardstands, and so on are documented in each organization's Mobilization Table of Distribution and Allowances (MOBTDA), along with the unit's personnel and equipment needs. Decision point 3.3.1. determines how many of the facilities represent new construction requirements.

Decision Point 3.3.2.

The Corps of Engineers has other support requirements during mobilization. Critical military projects not included on any installation's MOBTDA will require resources. Engineer support for disaster relief and civil defense, the nation's waterways, critical civil works projects, and special security needs must be resourced from somewhere. Decision point 3.3.2. considers all these variables and determines the number of projects and contracts needed.

Decision Point 3.3.3.

Decision point 3.3.1. and 3.3.2. develop organizational staffing requirements data that need to be further refined by processes outlined in Forces Command's guidance: the U.S. Army Forces Command Mobilization and Deployment Planning System. The resulting information is fed into the engineer organization's MOBTDA.

Commander's Support Books

When the engineer commander is also the installation commander, the unit MOBTDA will include activities shared by tenant units (for example: central mess, health and motor pool facilities). When the engineer organization is a tenant on an installation, the engineer commander must negotiate such support from the installation commander.

MOBNET promises to be a giant step forward in the Army's planning process, and can provide the means to link national strategy to mobilization requirements.

The Information Systems Command is currently working with the Army staff to incorporate MOBNET concepts into the Army World Wide Military Command and Control Information System. Copies of the final study report, Army System for Mobilization Requirements Planning: Supply Classes V and VII (Ammunition and Equipment), are available through the Defense Technical Information Center (Report No. DA313826), Cameron Station, Alexandria, VA 22304.

Mr. Atkinson is a project manager for the U.S. Army Engineer Studies Center at Fort Belvoir. He is a West Point graduate, and served in armor and aviation units in Europe and Vietnam. His postgraduate education includes law and information systems management.

(Engineer Safety continued)

The 18 incidents involving M915-series vehicles accounted for only 3 percent of the total engineer accidents, but they caused more than $1 million in damages. The most costly accidents were caused by vehicles striking overpasses and improper clearance of loads. Loss of vehicle control due to air pressure loss on downgrades and improper hazard avoidance are other significant errors.

Training operators of M915 series vehicles is a challenge for engineer commanders. To aid in this effort, the Transportation School has developed an exportable training package which is scheduled for release in the second quarter of FY 91.

The Engineer School has taken the initiative in reducing work-related accidents by adding risk-management training to the program of instruction (POI) for officer and NCO courses. Risk management is the systematic process of making operations safer without compromising the mission. (See article in July 1989 issue of ENGINEER).

Accidents cost precious resources—people, equipment, and the costs of damages. To reduce these losses, engineer leaders must stress the importance of performing to standards and following established procedures. Engineer soldiers must follow the established standards—and we must all take the initiative to prevent accidents both on and off duty. Let's work together to reduce this needless waste.

Captain Torres is the engineer branch liaison officer at the U.S. Army Safety Center, Fort Rucker. Mr. Paul Rusinko is a safety specialist in the Engineer Branch Safety Office, Fort Leonard Wood.

ENGINEER UPDATE

Directorate of Training and Doctrine (DOTD)

Distribution to Persian Gulf Area. The ENGINEER Professic
Bulletin will be distributed to engineer units in the Persian Gulf ar
Therefore, it will not be necessary for units to forward copies mailed
addresses on our regular distribution list.

Live Mine Training. Engineer units are now authorized live m
training, subject to the following policy guidance:

- Training will be allowed with live M15, M16, M19, and M21 mines
- No training will be allowed with live M14 mines.
- All approved mines will be armed/disarmed not more than 25 ite
  tions per mine and/or fuse.
- No trip wires or booby traps will be used.
- Use of tilt rods with live mines is prohibited.
- Training with the M16 antipersonnel mine will be done with the p
  tive safety pin remaining in the M605 fuze.
- No pre-1957 M605 fuzes will be allowed in training with the M
  antipersonnel mine.
- Live mine training and simulator training will not take place con
  rently at the same location in order to preclude a live mine be
  mistaken for an inert mine.

The Engineer School will forward a live mine training model risk
sessment plan to engineer units by March 1991. POC is CPT
Glass, AV 676-7784 or (314) 563-7784.

Engineer Publication Support. Field units must order engir
publications from the Distribution Center in Baltimore, MD, using t
unit publication account number. The Engineer School is unable t
these requests. If you are in a hurry, use the Distribution Cent
hotline—it can handle requests for a limited number of some publ
tions. Call AV 584-2533 or (301) 682-8529.

Standards in Weapons Training, DA PAM 350-38. The trai
standards, strategies, and resource requirements to conduct trai
with engineer systems, mines, and demolitions are updated in
PAM 350-38, dated 24 September 1990. Training programs are
tied directly to the soldier's training publications (STP) and mis
training plans (MTP). Revised standards, strategies, and ammun
requirements for light engineer units are also provided. For more i
mation, call CPT Jim Glass, AV 676-7784 or (314) 563-7784.

ARTEP 5-415-MTP Series Update. Coordinating drafts for the
lowing six manuals in this series are scheduled for distribution to
propriate units for review in February 1991.

ARTEP No.	Unit
5-415-MTP	Headquarters and Support Company
5-415-13-MTP	Construction Equipment Platoon
5-415-14-MTP	Maintenance Platoon
5-415-15-MTP	Equipment Support Platoon
5-415-17-MTP	General Construction Platoon
5-415-31-MTP	Engineer Company

POC is CPT Robert Kurtz or SFC William King, AV 676-75
(314) 563-7599.

Reserve Configured Courses. The following Reserve Configured Courses, developed in FY 90, can now be ordered through normal channels:

MOS Reclassification	BNCOC	ANCOC
12B10	12B30	CMF81
12C10	12C30	
62F10	12F30	
62H10	62N30	

POC is Don Rowland, AV 676-7520, or Jim Fitzgerald, AV 676-7521 or (314) 563-7520/7521.

Directorate of Combat Developments (DCD)

Safety Flash! Mine Malfunction Accidents. Units must report near-miss accidents or problems with munitions promptly. Frequently near-accidents are not reported because "No one got hurt" or "It's too much paperwork." Not true—reporting one defect in time may save lives or prevent accidents. We need this information at the Engineer School to know where potential problems exist.

Soldiers can use the Engineer hotline to report munitions problems and near-miss accidents. Call AV 676-7324 or (314) 563-7324. Messages should include a POC (name, unit, and telephone number), ammunition type, and lot number. We will do the paperwork and get back to you for details.

If possible, do not destroy the evidence. Alert your local logistics assistance representative or quality assurance specialist for ammunition surveillance (QASAS) before you blow the munitions in place. POC is SFC Adams, AV 676-7330.

Engineer Branch Safety Office (EBSO)

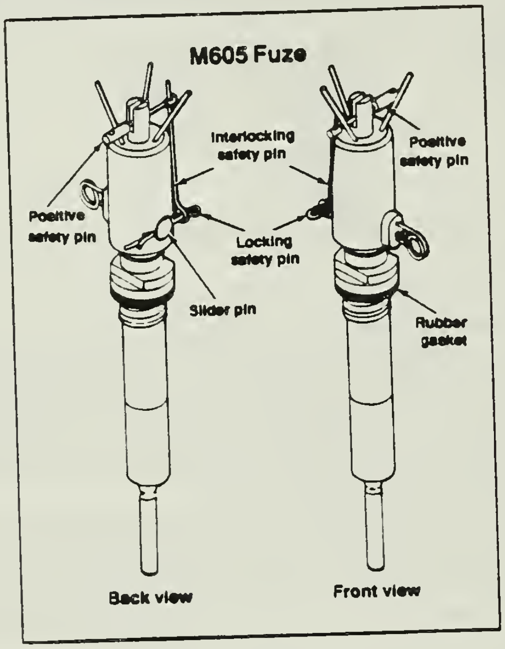
Caterpillar (Cat) M130G Road Grader Battery Removal. When removing or installing batteries in the Cat M130G, soldiers must disconnect the positive cable from the right side battery first and reconnect it last. Failure to do so will damage the grader's electrical system. This information is in Change 1 to TM 5-3805-261-14&P-2, page 1-82.

Road Grader Operation. As a result of a fatal accident, the following instructions have been added to training for road grader operators: Before shifting into reverse, road grader operators must stand up and look to both sides and the rear. The operator will remain standing while moving in reverse. All mirrors will be adjusted for maximum rearward vision of the individual grader operator when seated. We recommend that the camouflage net be carried in a support vehicle or on top of the cab, where it cannot obstruct vision. POC is Paul Rusinko, AV 676-5002 or (314) 563-5002.

Department of Combined Arms (DCA)

Field Manual (FM) 90-13-1. The combined arms breaching operations manual, FM 90-13-1, is scheduled for distribution in the 2nd quarter of FY 91. The Engineer School recommends all combat engineer units make it required reading for officers and senior NCO. The manual describes the combined arms doctrine and some tactics, techniques, and procedures needed to successfully overcome obstacles. An example of an instride breaching operation is described in the Engineer Problem/Solution, beginning on page 18. POC is CPT Bob Wray, AV 676-5456 or (314) 563-5456.

Department of Military Engineering (DME)



Arming/Disarming Procedures for M16 Series Antipersonne Mine (M605 Fuze). The following instructions and warning regardin arming/disarming procedures are in addition to those contained in F 20-32, dated December 1985. This information updates only a ming/disarming procedures. It does not modify in any way Departmen of Army policy on training with live mines.

- Individual must be in a prone position prior to arming/disarming th mine.
- ***Warning:*** *After the positive safety pin is removed, the slider ma detonate the mine if it is pushed in accidentally.*

- The slider is the mechanism that holds the striker up (keeps it fro firing) after the positive safety pin is pulled.

- Before it is pulled, the locking safety pin is located in the hole the rear of the slider.

- Individuals should keep their fingers away from the rear of th slider when arming/disarming the M16 series antipersonnel mine w the M605 fuze.

POC is CPT Green, AV 676-5596, (314) 563-5596.

Professional Engineer Application Deadline. The deadline for su mitting applications for the 25 October 1991 Professional Engineer (P Exam is 27 June 1991. This deadline applies to most states. The Co monwealth of Virginia allows the PE exam to be taken in other locatio If you wish to receive a Virginia application, call (804) 367-8512.

Department of Topographic Engineering (DTE)

Engineer Officer Advance Course (EOAC) Update. Instruction the intelligence preparation of battlefield process (IPB) has been inc porated into EOAC to ensure officers receive the most current terr analysis and intelligence training available. Officers attending EO after Class 1-91 will receive this improved training.

The IPB instruction will be taught in one day to help students be understand the process. Students will prepare a terrain analy product and decision support template, which will be used to supp tactics training. POC is CPT Wood, AV 676-5416 or (314) 563-5416

Task/Site Selection Boards. A task/site selection board for M 81C (cartographer) was held in January 1991. The resulting task for the Soldier's Manual and resident training is expected to be av able for distribution in 3rd quarter, FY 91. POC is SFC Robert Kr AV 676-5417.

A task/site selection board for MOS 83E (photo/layout specialist) is te tively scheduled for April 1991. POC is SFC Bobby Odom, AV 676-5404

Engineer Personnel Proponency Office (EPPO)

Engineer Officer and Warrant Officer Directory. The new ac duty Engineer Officer and Warrant Officer Directory is available purchase from the Superintendent of Documents, Government Prin Office, Washington, D.C. 20402. Copies are $12 each. You may (202) 783-3238 and use VISA or MasterCard. The stock numbe the directory is 008-022-00268-5.

1st Brigade

Sapper Leader Course Openings. Several Sapper Leader Co classes for FY 91 are only partially filled due to Operation D Shield. The following classes and slots are available:

Class	Dates 1991	No. Slots Available
4-91	25 Feb - 25 Mar	25
5-91	18 Mar - 15 Apr	25
6-91	8 Apr - 6 May	25
7-91	29 Apr - 27 May	25
10-91	1 July - 29 July	25
13-91	2 Sept - 30 Sept	25

The Sapper Leader Course is open to any U.S. Army engineer unit, with priority given to light, airborne, divisional, and corps combat engineer units. Combat heavy and Reserve Component units are invited to apply for class slots. Units should contact Fort Leonard Wood's Directorate of Plans, Training, and Mobilization (DPTM), at AV 581-3195/3148, or (314) 596-3195/3148. For more course information, call AV 581-6725/6225 or (314) 596-6725/6225. POC is 1LT Jeffrey Harrison.

Reserve Component (RC)

Engineer Officer Basic Course (EOBC-RC). Soldiers must complete the correspondence phase of EOBC-RC prior to attending the 8-week resident phase (OCS graduates). This is a change! POC is LTC Charles Doll, AV 676-7742 or (314) 563-7742.

Engineer Commanders Conference. The conference, now known as the Senior Engineer Leaders Conference, is scheduled for 17-20 April 1991, at Fort Leonard Wood. It is for battalion and above commanders and their command sergeant majors. POC is CPT Bonhurst, AV 676-7015 or (314) 563-7015.

News and Notes

Battle Staff NCO Course. Starting in January 1991, a new Battle Staff NCO Course, at Fort Bliss, Texas, will train battalion and brigade staff NCO (S1 through S4 and G1 through G4) to serve as integral members of the battle staff and to manage day-to-day operations of battalion command posts. The 6-week course will train battle staff NCO to function and fight as an effective team. Beginning class dates for 1991 are: 14 January, 1 April, 20 May, 8 July, and 26 August. For more information, call the chief instructor, AV 978-9165 or 8145, or (915) 568-9165 or 5145.

Senior Officer Logistics Management Course (SOLMC). A 1-week course designed to update commanders and their primary staff at the battalion and brigade levels in the logistics arena is available at Fort Knox, KY. The course is open to officers in grade major or above in active and reserve Army, U.S. Marine Corps, and allied nations, and DOD civilians in grade GS-11 or above. Ten classes are planned for FY 91. For more information, call CPT Hammerle, AV 464-7133 or (502) 624-7133.

The Corps of Engineers' 124th Annual Engineer Dinner. All Active, National Guard, Reserve, and retired officers, non-commissioned officers, and Corps civilians are invited to the 124th Corps' Annual Engineer Dinner. It will be held on Thursday, February 21, 1991, 1830 hours, at the Fort Myer Officers' Club, Fort Myer, VA. Cost is $32 per person. Payments may be mailed to 124th Annual Engineer Dinner, ATTN: DAEN-ZCA (T.Kay), Room 1E676, the Pentagon, Washington, D.C. 20310-2600. POC is MAJ Joe Miller, (703) 693-4583.

Engineers as Infantry in the Korean War

By Dr. Barry W. Fowle

Not all wars start with prior warning. The Korean Conflict was one such war. And, it was one that illustrates the United States' ability to respond quickly to armed aggression.

When the North Koreans launched an attack across the 38th parallel into the Republic of Korea (ROK) on June 25, 1950, they hoped for a speedy victory. Two days later, the United Nations Security Council passed a resolution asking members to assist the ROK in repelling the attack and restoring peace. On June 29, President Truman authorized General of the Army Douglas MacArthur to use ground units in Korea.

No American combat units were in Korea when the communists invaded, and there were few trained U.S. Army divisions available for immediate commitment. The Eighth U.S. Army, stationed in Japan, immediately alerted its four divisions for combat in Korea, even though the units were under strength and mainly unprepared occupation troops. As a result, many noninfantry units were used as infantry in the early days of the war.

The first two divisions to reach Korea, the 24th and 25th Infantry Divisions, arrived in early July. Third to arrive was the 1st Cavalry Division, to which the 14th Engineer Combat Battalion (ECB) was attached. Initially short two companies, the battalion was assigned two more, one from the 43rd ECB and one from the 13th ECB. The battalion's strength was then 32 officers, 3 warrant officers, and 648 enlisted men.

The 14th ECB arrived at P'ohang-dong, Korea, on July 18. Relieved of attachment to the 1st Cavalry Division, the battalion went to Pusan to support the 25th Division. At the end of July the battalion moved to Taegu, where it was attached to the 24th Infantry Division, with further attachment to the 21st Infantry Regiment. The regiment was located along the Naktong River, and the battalion established a forward command post near Tukson-dong.

For the next three weeks, the 14th ECB helped hold the Pusan Perimeter. The unit performed a mix of engineer and infantry missions in several actions scattered throughout the 24th Infantry Division area. Their actions typify those of other engineer units called on to provide engineer support and accomplish infantry missions.

Company A's first mission was to prepare a 650-foot steel girder bridge across the Naktong for destruction, while Company C prepared the road out of Koryong for demolition. The demolitions were blown on August 3, when new defensive positions were established in the rear, further shrinking the Pusan Perimeter. The battalion then re-established its command post near Ch'angnyong.

In an effort to hold the positio
against North Korean attacks, t
21st Infantry Regiment task
Company C to send 12 men a
four .50-caliber machine guns
its defensive line along the Na
tong River. Engineers ended
manning seven .50-calib
machine guns, including thr
guns belonging to the infantry.
August 5th, the company was
dered to man the defensive li
along the Naktong. Company
was tasked to lay an anti-perso
nel minefield with booby traps
front of the division.

The following day, Company
dug defensive positions for
regiment. Company C moved t
new position on line. After digg
in, Company C made contact w
a 50-man enemy patrol trying
cross the Naktong and killed
wounded 46 of the enemy. For
next several days Company C s
out patrols and set listening p
along the river.

On August 10, the 21st Infan
Regiment assigned Compan
the mission of perimeter defe
for units of the division's artill
Company A installed 200 yard
double-apron barbed wire fe
and an anti-personnel mine
as part of the perimeter defen

A period of intense enemy
tivity began on August 11.
morning, Company A and
ments of Headquarters and
vice Company were tasked

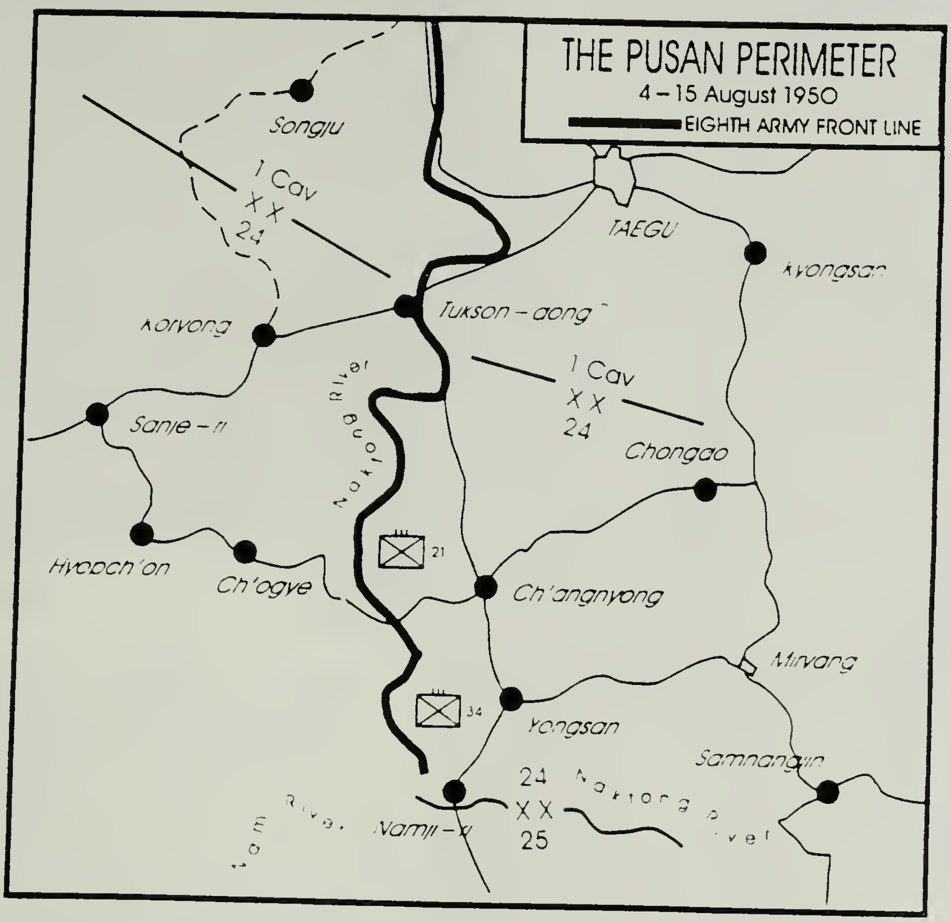
perform infantry missions. North Koreans had infiltrated into the 24th Infantry Division's sector of the Pusan Perimeter. Enemy artillery fire rained down on Yongsan, while sniper fire harassed traffic on the road from Yongsan to Miryang. South of Yongsan, North Koreans killed all members of a squad of K Company, 34th Infantry. The squad had been guarding a bridge over the Naktong at Namji-ri, which connected the 24th and 25th Divisions.

In response to the enemy threat in the rear against the main supply route (MSR) between Yongsan and Miryang, the 24th Infantry Division sent engineers to an area just east of Yongsan. This detail was ordered to keep open a 3-mile section of the MSR between Yongsan and Miryang.

Beginning at a point 2 miles outside of Yongsan, the engineers set up four road blocks extending from west to east. A five-man jeep patrol was to check each post every hour. The patrol's first trip went smoothly, but on its second trip enemy fire wounded the driver. Road block 3 received small arms fire.

When road block 4 began to receive considerable fire, the platoon leader sent his men to an infantry platoon's position one-half mile to the east. He and two noncommissioned officers (NCO) then headed for road block 3, which was under attack by enemy machine guns, rifles, and grenades. They never made it. North Koreans killed one NCO and captured the other two.

Enemy fire was now heavy at road block 3. A hand grenade killed the platoon leader and wounded three enlisted men. When an NCO tried to lead eight men to road block 2, enemy fire killed all except the NCO, who finally reached safety. At road block 2, the communications officer was wounded by three rounds as he tried to adjust a machine gun.



Engineers at road blocks 1 and 2 successfully defended their positions until the 34th Infantry Regiment ordered them to stop infiltrators at a hill northeast of Yongsan. Enemy troops posing as civilians had moved behind the line using a draw to the south of the hill. Late on the 13th, having stopped the North Korean infiltration, the engineers reported back to their command post. That evening it became apparent that the prompt action of the 24th Infantry Division in committing engineer troops to the MSR had checked the dangerous enemy penetration in the Yongsan area.

In three days of fighting, the battalion lost 24 men killed, three missing in action, and four wounded in action. Four soldiers earned the Silver Star.

Until relieved from attachment to the 24th Infantry Division on August 24, the 14th ECB continued in its dual role as engineers and infantry. Company A maintained the MSR from Chongdo to Ch'angnyong, Company B established a perimeter defense for the field artillery, laid a 300-yard minefield along the Naktong, and did limited work on the MSR from Ch'angnyong to the front. Company C continued in its defensive position along the Naktong.

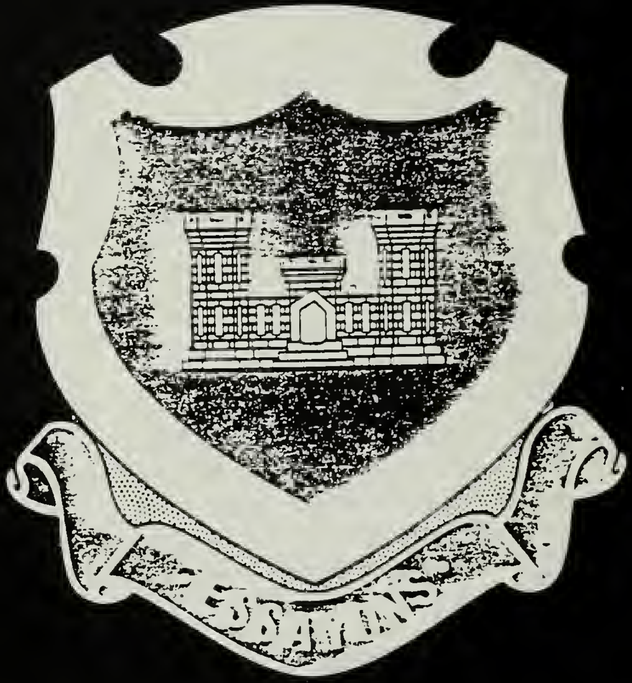
Because no engineer unit knows when it will be called upon to perform an infantry mission, soldiers must be prepared to respond to such missions at a moment's notice. The 14th Engineer Combat Battalion was one unit called on to fulfill both functions in an emergency situation, and it responded brilliantly.

Dr. Barry Fowle is a historian, Office of History, Headquarters, U.S. Army Corps of Engineers, Fort Belvoir, VA. He earned a Ph.D. in history from the University of Maryland.

DEPARTMENT OF THE ARMY
ENGINEER PROFESSIONAL BULLETIN
US ARMY ENGINEER SCHOOL
ATTN: ATSE-TDM-PB
FORT LEONARD WOOD, MO 65473-6650

USPS 522-390
OFFICIAL BUSINESS

SECOND-CLASS MAIL
POSTAGE AND FEES PAID
DEPARTMENT OF THE ARM
ISSN 0046-1989



NEXT IN ENGINEER

- An Interview with MG Schroeder
- AirLand Battle-Future Concepts
- Combined Arms Training Strategy
- Operation Cross My Heart
- and more...

PIN: 046480

Engineer

April 1991

PROFESSIONAL BULLETIN FOR ARMY ENGINEERS
dquarters, Department of the Army

Engineer 2000

An Interview with Major General Daniel R. Schroeder

Engineer Initiatives for Desert Shield

PB 5-91-2

Approved for public release; distribution is unlimited.

RETOOLING WITH DIGNITY

By Major John Davison

Operation Desert Storm has occupied our minds the past six months and focused our energies on getting that mission accomplished. During this crisis, thoughts of reducing the size of United States' armed forces, a hot topic only a few months ago, have faded from public view. But probably not for long. Recent news articles state the "build down" will resume.

In April 1990, General Vuono, Chief of Staff of the Army, explained the why's and how's of building down the force. He indicated the Army would keep good soldiers and maintain career viability. At the U.S. Army Engineer School, we are addressing part of that issue by looking at combining certain engineer military occupation specialties (MOS).

In this article, I will address one component of the force reduction initiative—reclassification training of non-commissioned officers (NCO).

The build down (force restructure) and need to keep good soldiers will create overages and shortages throughout the enlisted personnel management system. This, in turn, will create a need to reclassify soldiers to meet requirements in the new force structure.

It is not a new dilemma for the Army. In the 1970s, the Army restructured the force to gain more "teeth" in the combat arms, and less "tail" in the service support arms. We did this by combining MOS and reclassifying soldiers. As a training unit company commander at Fort Leonard Wood at that time, I received forced reclassification soldiers through the rank of staff sergeant. All soldiers attended the entire initial entry training (IET) course, regardless of their rank.

Today's Army needs a better, educationally based instructional model to retrain NCOs—one based on credit for experience and maturity, as well as respect for members of the NCO Corps. This does not mean we can accept anything less than established performance standards for the new MOS. Every NCO must know his job. And, there is no substitute for personally building a bridge, emplacing a mine, or operating equipment.

I believe the Reserve Component School Model (RC3, Reserve Component Configured Courseware) can be used to properly retrain and retool NCOs efficiently and economically. The program provides classroom and field learning environments, interaction with other students, trained instructors, and most importantly, hands-on experience with the equipment and materials used by soldiers the NCOs will soon supervise.

In 1990 the Engineer School exported more than 8,000 student training packages to more than 150 Reserve Component Training Institutions (RCTI) located on Active, Reserve, and National Guard posts in all 50 states, Puerto Rico, and Germany. Most of them were for MOS reclassification training.

To ensure high quality training, all instructors are MOS qualified, instructor training course qualified, and use the instructional materials provided by the Engineer school. Programs of instruction (POI), course management plans (CMP), lesson plans, and exams are also provided. The CMP list all required equipment, ammunition, training areas, etc., needed for the hands-on experience required to award the MOS.

The RCTIs also receive assistance from Readiness Groups, CONUSAs and proponent schools Directorates of Evaluation and Standardization, further ensuring quality standards. Currently, the Regional Training Sites-Maintenance are receiving accreditation visits from team members furnished by the Engineer School

There are several benefits fo the "One Army" reclassification c all NCOs through the RC Schoo Model. First, students in eac class are all MOS qualification c reclassification soldiers of close age and maturity—the progra allows retooling with dignit Second, the training blends Activ and Reserve Component NCO e periences, improving the on Army concept.

A major benefit is cost effectiv ness. Because RCTIs activate on when we need to train soldiers meet a specific requirement, the is low overhead in permane staff. Travel costs are significant reduced because soldiers atte nearby facilities. Also, there is permanent pool of equipme waiting for the next cycle; in ma cases, the RCTIs pull togeth

(Continued on page 44)

Engineer

April 1991

DEPOSITORY

MAY 1 0 1991

UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

Volume 21 PB 5-91-2

UNITED STATES ARMY ENGINEER CENTER AND FORT LEONARD WOOD

COMMANDER/COMMANDANT
Major General Daniel R. Schroeder

MANAGING EDITOR
Catherine Eubanks

FEATURES EDITOR
Phillip R. Howell, Jr.

GRAPHIC DESIGNER
Jennifer C. Bolyard

By Order of the Secretary of the Army:

CARL E. VUONO
General, United States Army
Chief of Staff

Official:

PATRICIA P. HICKERSON
Colonel, United States Army
The Adjutant General

***Cover photo:** Soldiers of the 24th In-antry Division check their M-21 mine n a beach in Saudi Arabia. U.S. Army hoto by Gil High.*

FEATURES

4 **Engineer 2000**

9 **Combined Arms Breaching**
by Captain James R. Brannon

13 **Engineers And Combined Arms Training Strategy**
by Captain Robert Kurtz and Captain Chris Nolta

17 **MOS Qualification In The Pacific**
by Captain William E. Bowers

20 **An Interview With Major General Daniel R. Schroeder**
by Phillip R. Howell, Jr.

28 **Readiness: It's Everybody's Business**
by Colonel Ron Dabbieri

38 **Force Structure And AirLand Battle-Future**
by Major Joseph M. Seerley

42 **Engineer Materiel Support For AirLand Battle-Future**
by Charles Manning

48 **Engineer Brigade Initiatives for Desert Shield**
by Colonel Robert B. Flowers and Lieutenant Colonel James E. Meredith

54 **Can You Hear Me, Lieutenant?**
by Lieutenant Colonel Herb Harback

59 **Engineer MOS Consolidation**
by Dr. Sue Mettlen

60 **The CEV M970 Subcaliber Training Device**
by Sergeant First Class Dennis L. Fulton

DEPARTMENTS

Inside Front Cover: **Personal Viewpoint**

2 **Clear the Way**
3 **Bridge the Gap**
32 **Engineer Problem**
41 **Book Review**
45 **Engineer Solution**
52 **Lessons Learned**
62 **Engineer Update**
64 **Past In Review**

ENGINEER (ISSN 0046-19890) is prepared quarterly by the U.S. Army En-neer School, ATTN: ATSE-TDM-PB, Fort Leonard Wood, MO 65473-6650. cond Class postage is paid at Fort Leonard Wood, MO, and additional mailing fices.

POSTMASTER; Send address changes to ENGINEER, the Professional Bul-In for Army Engineers, ATTN: ATSE-TDM-PB, Fort Leonard Wood, MO 65473-50.

CORRESPONDENCE, letters to the editor, manuscripts, photographs, official t requests to receive copies, and unit address changes should be sent to EN-NEER, at the preceding address. Telephone: (314) 563-7762, AV 676-7762.

DISCLAIMER: ENGINEER presents professional information designed to keep my engineers informed of current and emerging developments within their areas of expertise. Views expressed are those of the author and do not necessarily reflect official Army or TRADOC positions, nor does the content change or supersede information in other official Army publications. ENGINEER reserves the right to edit material.

CONTENT is not copyrighted. Material may be reprinted if credit is given to ENGINEER and the author.

OFFICIAL DISTRIBUTION is targeted to all engineer and engineer-related units.

PERSONAL SUBSCRIPTIONS are available by contacting the Superintendent of Documents, ATTN: Chief, Mail List Branch, Stop SSOM, Washington, DC 20402. Address changes for personal subscriptions should also be sent to the Superintendent of Documents.

CLEAR THE WAY

By Major General Daniel R. Schroeder, Commandant, U.S. Army Engineer School

Our victory in the Persian Gulf reflects positively on the Engineer Center's ability to train soldiers. We have focused on training to standards to provide warfighting commanders with highly motivated, physically fit, and MOS-qualified soldiers, and an engineer force that can operate as an integral part of the combined arms team. Our engineer force with Desert Storm is performing superbly, and is a fine example of training dividends.

Until the Persian Gulf crisis threatened world peace, the U.S. Army was beginning a major organization "build down" that probably will continue. The azimuth for this effort is focused on preserving a quality force, as articulated in the Chief of Staff's six imperatives. A strategic force that is versatile, deployable, and lethal will result from this initiative.

The Army will transition to a forward deployed, CONUS-based force that is capable of large-scale deployments such as Desert Shield, small-scale deployments, and nation assistance. Strategic focus will shift to contingency and reinforcement, nation assistance, and unique mission forces. Tactical focus will be on a more aggressive, offensive, and nonlinear concept of warfare.

We must pool our defense resources and build defense muscle. With our allied forces, we will use numerous forums to achieve the rationalization, standardization, and interoperability needed to conduct successful military operations using coalition warfare. Regularly scheduled staff talks, the North Atlantic Treaty Organization (NATO), and the American, British, Canadian, Australian (ABCA) (Quadripartite) Armies Standardization Program are designed to eliminate obstacles to cooperation.

Although the world's geopolitical environment is in turmoil, the mission of combat engineers remains the same - to provide combat support to the warfighting force. For engineers to keep pace with the combined arms force, however, we must update the methods employed to accomplish our mission. This will lead to changes in doctrine for the way engineers fight and support maneuver, changes in training and force structure, and the production or improvement of engineer equipment.

The Army's style of fighting must adjust to a changing world. AirLand Battle-Future (ALB-F) is designed to defeat the enemy's main effort at times and places of our choosing. Evolving engineer doctrine supports the ALB-F concept of fighting on a non-linear battlefield. Doctrine will continue to emphasize interoperability among the allied nations, joint forces, and the combined arms.

Battlefield mobility must be improved before we can implement ALB-F concepts. We need to move faster, strike harder, and finish quicker to win future battles. As Confederate General Nathan Bedford Forrest noted, the key to success in battle is to "Get thar fustest with the mostest." Engineer support to offensive operations is the key to getting there first with the most. Effective countermine and complex obstacle breaching capabilities are vital to improving friendly mobility.

Mine warfare will change drastically. Our goal in mine warfare is to counter the enemy's mobility and degrade their forces without human intervention. Future minefields will serve as combat multipliers in gaps or where few friendly forces are located. Countermobility efforts will focus on state-of-the-art mine systems with remotely controlled and "smart" technology.

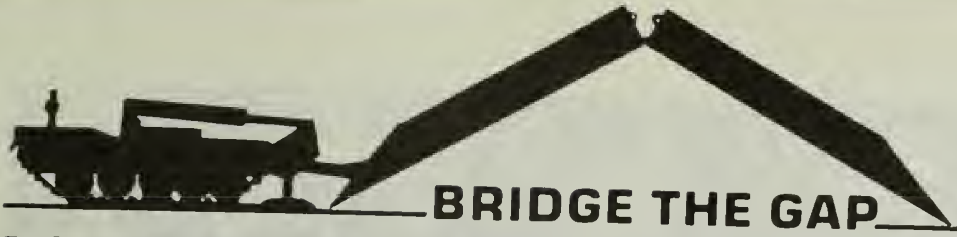
The wise use of terrain will become increasingly important on the future battlefield. Topographic engineers will supply real-time topographic support to help maneuver commanders understand how terrain can help win a battle.

Communications and automation will be critical on the fast-paced future battlefield. Commanders must exploit the intelligence, logistical, and maneuver aspects of warfare at the critical moment.

Materiel solutions to engineer equipment problems and battlefield deficiencies will continue to be found by the Directorate of Combat Developments. Although research, development, and procurement dollars are scarce, we must modernize our engineer force.

Engineers lead the way in planning for a lean, effective Army. Our restructure initiative will realign engineer support to the maneuver force, and produce a leaner, more lethal, and more mobile engineer force than we have today.

And, tough, realistic training is imperative to readiness. Leadership, combat engineering, and hard engineering will continue to be emphasized. Your Engineer Center is committed to producing engineer soldiers who can respond appropriately to the complex challenges that face the combined arms team. The future will demand much from us, but the Regiment will, as it always has, clear the way.



BRIDGE THE GAP

By Command Sergeant Major W.E. Woodall
U.S. Army Engineer School

Awards, and the recognition they provide, are important to all of us. I will take this opportunity to talk about an award steeped in Army tradition that may be presented to Army officers, non-commissioned officers, or civilians. Specifically, I will discuss the de Fleury Medal, which is administered by the Engineer Regiment.

When the Corps of Engineers adopted the "whole branch" concept of the Army Regimental System in 1986, our leadership recognized a need to preserve our history and traditions and to provide a means of instilling pride in the Corps. The senior engineer leadership discussed several ways to accomplish that mission, and decided to create a special award to bestow on people who made significant contributions to the Regiment. This award would derive its heritage from the very beginnings of the U.S. Army Engineers, the Revolutionary War. And, it would be a source of pride and prestige for the recipient and the Corps itself.

Research revealed that the Continental Congress of the United States had issued such a medal to one of our first engineers of courage and boldness in an important battle: Captain Francois de Fleury, a former French soldier who enlisted in America's fight for democracy.

With his background and education, de Fleury was commissioned a captain of engineers. As an assistant to Baron von Steuben, he helped write a drill manual that contributed much to the war effort. Then, on June 1, 1779, the British captured two small forts on the Hudson River, about 30 miles from Manhattan Island. A special corps of hand-picked combat veterans was formed to recapture the forts, one of which was Stony Point. BG "Mad" Anthony Wayne was in charge of the operation; de Fleury was second in command of the 1st Regiment.

Stony Point was surrounded by 150-foot cliffs, rocky slopes, and swamp. To provide an additional barrier system, the British had constructed strong entrenchments and double abatis. Thus, the Amercan's decided that conventional tactics could not be used to recapture the fort. Instead, their attack would ake place in total darkness in order to gain surprise. Except for a small diversionary group, the soldiers were ordered to unload all weapons and turn in all ammunition.

Then, as now, engineers went first. Sappers wieldng axes breached the abatis in front of the advancing infantry. With his commander wounded and fallen, de Fleury led the American soldiers through the withering fire and was first over the wall. Fierce hand-to-hand combat raged, and De Fleury was personally credited with striking the British colors from their staff and trampling them underfoot.

For his courageous behavior, the Continental Congress awarded a medal struck in de Fleury's honor. Benjamin Franklin commissioned the chief engraver of the French National Mint to cut the die. It is understood that the de Fleury Medal was the first Congressional Medal struck, if not the first medal authorized. George Washington was one of the first recipients.

The Engineer Regiment adopted the de Fleury Medal as their award in 1989 because of the values demonstrated by the man for whom it was struck—values with special meaning to engineer soldiers.

There are three levels of the award. To be eligible for a bronze medal, an individual must have rendered significant service or support to an element of the Engineer Regiment. The bronze medal may be approved by a member of the Engineer Regiment who is a colonel currently in command; a divisional engineer battalion commander; an engineer district commander; DEH director with the rank of lieutenant colonel; the president, Engineer Regimental Association; or a general officer.

The silver medal must be approved by the Commanding General, U.S. Army Engineer Center and Fort Leonard Wood. It is awarded to a person who has rendered outstanding and significant support or service to the Engineer Regiment.

One gold medal is awarded annually by the U.S. Army Chief of Engineers to an individual who exemplifies boldness, courage, and commitment to a strong national defense.

The Engineer Regiment began presenting de Fleury Medals after the Engineer School moved from Fort Belvoir to Fort Leonard Wood in 1989. To date, more than 150 medals have been awarded to persons ranging from sergeants to generals, the chief of staff of the French Army, and civilians. Anyone with the knowledge of the facts showing the criteria have been met may start the award process.

Today the de Fleury medal is awarded for the same reason that the Continental Congress awarded the original in 1779—for outstanding service to the Regiment and the nation.

Engineer 2000

The White Paper, Engineer 2000, has been prepared to address the azimuth for the Corps of Engineers as we move into the twenty-first century. The following article is a condensed version of the paper, covering some of its more important issues that I want to share with you.

The Army is changing. The events in the world's political environment in the past two years have created a watershed of changes in priorities clearly impacting on our profession. Yet, the mission of the combat engineer has been, and will continue to be, to provide combat support to the war-fighting force.

It is the structure and purpose of the new war-fighting force, and the scope of our combat support, that must be understood if we are to move into the next century as a true member of the combined arms team. Steady leadership, focused on the ultimate objective of improving our ability to execute our missions, and a commitment by all members of the force to achieve those goals are the essential elements of improving the Regiment.

To this end, Engineer 2000 has been prepared. It is purposely not specific in nature. It serves only as a guide to look at where we and our Army are going as we move toward the year 2000.

DANIEL R. SCHROEDER
Major General, U.S. Army
Commandant
U.S. Army Engineer School

> *"At every crossing on the road that leads to the future, each progressive spirit is opposed by a thousand men appointed to guard the past."*
>
> *Count Maurice Maeterlinck*
> *Belgian Philosopher, 1862-1949*
> *Nobel Prize for Literature, 1911*

The Engineer Center

Bold, diligent, technically competent, fully trained, and properly organized and equipped sappers of the twenty-first century will be the products of your Engineer Center. Today's engineers are moving through a period of transition to a leaner war-fighting force, mission-focused to support the commanders in chief (CINCs) in whatever contingency, nation assistance, or force sustainment role they face.

Through the next decade, we will continue to refine the tremendous training advantages of the new Engineer Center, where every engineer from private to colonel will receive their engineer training. Our efforts will establish your Engineer Center as the focal point of military engineering, training, and expertise in the world.

Fort Leonard Wood will see more changes in the future, with soldiers training in fewer military occupational specialties (MOS) and shorter, more concentrated professional courses. Increased use of automation and simulation will change the funding balance somewhat, but the net effect will be more training for the dollar.

Through this evolutionary period and well into the next century, the primary mission of the Engineer Center will remain the training of soldiers to become sappers and visionary leaders in the new total force. As never before, our sappers and their bold and aggressive leaders will have a role in preparing the Army to counter the emergence of new battlefield threats across the continuum of operations, and under any terrain and weather conditions.

An Azimuth For The Regiment

Changing world events have caused the United States to redesign its military strategy for war fighting and nation assistance. Critical missions for our Army in the year 2000 go beyond "shoot, move, and communicate." In supporting complex national

***Above and Left:* Changing world events will cause a strengthening of the Army engineer's dual role as a combat element and as a key player in nation assistance programs.**

and international priorities, we will be expected to provide support and assistance to developing democracies in South and Central America, expand the effort to combat the national and international drug trade, and most importantly, project our power worldwide to protect our vital interests. The Regiment is, and will continue to be, actively engaged in pursuing these purposes with no indication of a diminishing tempo.

"Any good Engineer Officer must wonder about the problems of the German Engineers in the assault on Stalingrad, and about the problems of the Russian Engineers in its defense. Any good Engineer will never pass a bridge but what he gives a thought as to how that piece of terrain might best be organized for defense, or as to how it might be attacked if it were organized by the enemy."

MG Eugene Reybold
Chief of Engineers
October 1942

Doctrine

AirLand Battle doctrine will continue to mature and adjust to a changing world. AirLand Battle-Future (ALBF) sees forces employed on a nonlinear battlefield. The key to ALBF is flexibility. While the Army will be smaller, it must remain versatile, deployable, and lethal. It will provide forward-deployed forces and be more capable with contingency, reinforcing, and nation assistance forces.

Our evolving engineer doctrine supports the ALBF concept. The doctrine for traditional fixed-battlefield functions—mobility, countermobility, survivability, sustainment engineering, and topographic engineering—is continuing to evolve as new techniques, procedures, and material become available. The force structure is also changing to meet the operational requirements of ALBF.

To win on the future battlefield, the deployability, survivability, lethality, effectiveness, and operational capabilities of the Army combat and combat-support forces must be maximized. However, with reduced force levels and emerging political, economic, and geopolitical environments, the complexion of future engagements is changing. With fewer forces, there will be large gaps in the lines. To compensate, commanders must analyze the capability of their forces as a function of the terrain, maintain fluid operations, and rapidly mass and disperse their forces on the nonlinear battlefield. Additionally, units must still be capable of conducting linear operations when needed.

Such combat operations of the future will exist throughout the depth of the battlefield. Commanders will capture and maintain the initiative through the highly synchronized and agile employment of forces. Operations will be conducted in overlapping, continuous stages. Sensor acquisition, fires, maneuver, and recovery stages will blend into a continuous, quick-paced process.

This will require commanders to exploit the intelligence, logistical, and maneuver aspects of warfare at the critical moment. The engineer, in mobility, countermobility, survivability, sustainment, and topographic engineering roles, is inextricably linked to every facet of the new battlefield.

"If used correctly before a battle, a platoon of engineers can be more valuable than a company of tanks."

Coyle, TEAM YANKEE

Organization

Engineer units on the future nonlinear battlefield will be leaner, more focused on combat, and better tailored to support brigade maneuver forces.

A sapper battalion organic to each maneuver brigade will enhance command and control, put more engineers forward in the battle area, and provide synchronization for the use of engineers as a combat multiplier. These sapper battalions will provide immediate engineer and topographic support to each brigade without the necessity or the time required to task organize for specific missions.

The division headquarters will include a division regimental engineer and staff. The regimental colonel will plan engineer operations, advise the division commander on engineer matters, and will plan and develop training guidance for the sapper battalions.

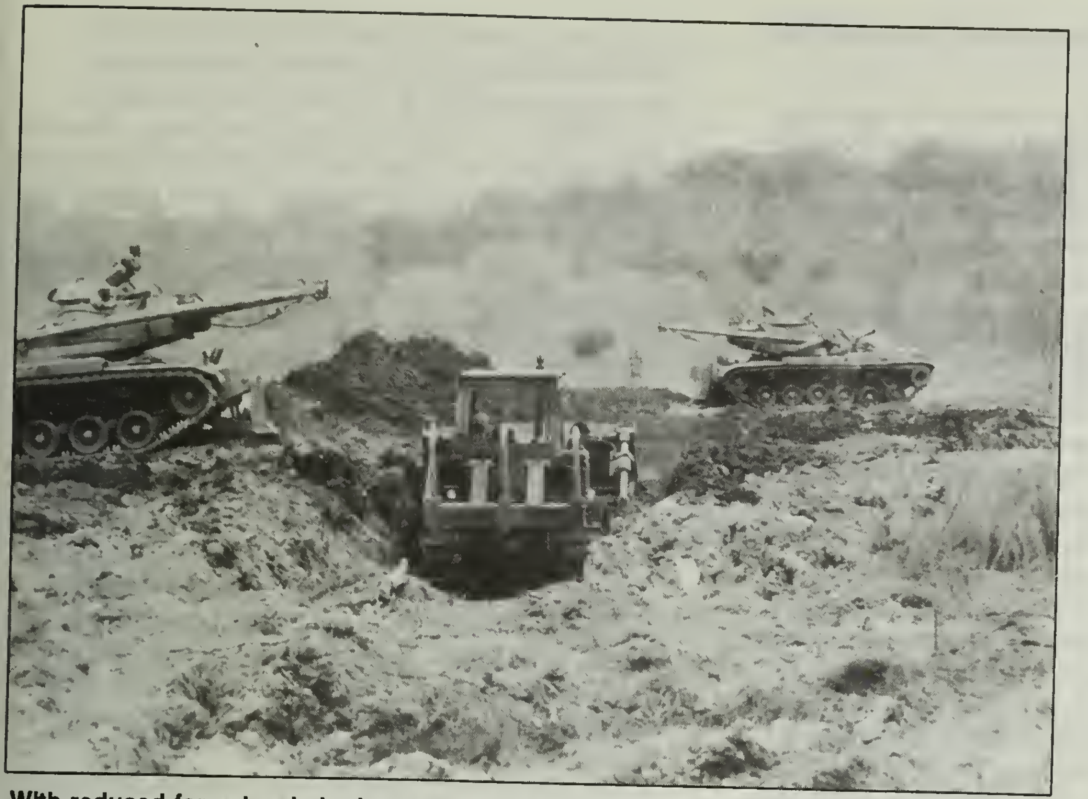
The corps commander, through the use of mechanized and wheeled combat engineer battalions from the corps engineer brigade, will support mobility and survivability of the maneuver brigades from the corps rear area to just short of where the fight is to occur. To ensure proper bridging assets are available where needed, all fixed- and float-bridge assets will be consolidated at the corps level.

Operations in Southwest Asia have shown that it is absolutely essential that engineers accompany the initial maneuver unit deployments to establish the sustainment base from which our forces will operate.

To meet the support needs of deploying headquarters, the present combat-heavy engineer battalion will evolve into a new structure, with new roles and missions. It will be able to support deploying, reinforcing, and contingency forces. As necessitated by shrinking budgets, it will also be designed to provide infrastructure support to continental United States (CONUS) installation commanders. The Army Reserve or National Guard round-out battalions, with one or more Active Army separate companies attached, will also be capable of fulfilling a nation assistance role when deployed.

In addition to his mobility, countermobility, survivability, and sustainment engineering capabilities, the division regimental engineer will have real-time topographic support through the division terrain team, which will be the primary topographic staff for the tactical commander. Through the next decade, topographic engineers will transition from a map production mission to one of providing battlefield environment information. Topographic engineers will be integrated into the total engineer force, providing direct and general support to corps and echelons above.

Engineer commanders will use the new technology and new organizations to play a major role in operational and tactical decision making. The engineer must be an active part of the commander's combined arms team at all levels, not just an advisor.



With reduced force levels in the next decade, commanders will have to maximize the capabilities of their units on the nonlinear battlefield. Such forces will have to be highly synchronized and agile.

> *Colonel Anderson reported the barrier lines shaped mainly by the 291st and 51st Engineer Combat Battalions were now in the hands of five infantry and three armored divisions, from Malmedy all the way back to the Meuse River. Little wonder that "...Peiper could only sit with leaden heart and face the fact that time had run out...he could only sit helplessly, pound his knee and swear, 'The damned Engineers! The damned Engineers!'"*
>
> *Colonel David E. Pergrin First Across The Rhine*

Materiel

New equipment initiatives for the force in 2000 focus on providing in-stride breaching and gap crossing, terrain visualization, intelligent/-autonomous mines and minefields, multispectral camouflage, and ncreased support to nation assistance. Near-term emphasis will be on systems enhancing terrain visualizaions and analysis for the maneuver commander and countermine systems.

The ability to breach minefields and obstacles in stride and under fire will increase the survivability and maneuverability of the combined arms team. A true in-stride breach capability will be realized with the fielding of the combat mobility vehicle (CMV). Another armored system, the new mine-clearing line charge (MICLIC), mounted on the armored vehicle-launched bridge (AVLB) chassis, has been effective in assault breaches. Should ongoing research and development programs be approved, mobility in 2000 will be further enhanced by the introduction of heavy assault bridging equipment and an improved ribbon bridge. Improved hand-held mine detectors, explosive line charges, improved dispersed explosives, and scatterable mine clearing devices are being developed to further enhance mobility.

Continued research and development of a scatterable mine system, improved fusing for conventional mines, an anti-helicopter mine, and concept exploration of intelligent and autonomous mines will improve our countermobility capabilities. Improved explosives systems will be developed to rapidly emplace antitank ditches. These systems may also be employed to create rubble obstacles in urban areas, to reduce obstacles, and for general purpose demolition tasks.

Soldier survivability has already been enhanced with the introduction of the M-9 armored combat earthmover (ACE) and the small emplacement excavator (SEE). It will be further upgraded by the fielding of developmental systems which quickly provide underground shelter and overhead cover to individual fighting positions, as well as multispectral camouflage and terrain masking technologies.

In the next decade, tactical topographic equipment will be supplemented, and eventually replaced, by compact, highly mobile, transportable, self-supportable, automated systems. A digital topographic support system will be fielded by the year 2000 to provide topographic information and terrain analysis.

> *"No method of education, no system of promotion, no amount of common sense ability is of value unless the leader has in him the root of the matter—The Fighting Spirit."*
>
> *Field Marshall Earl Wavell*

Training and Professional Development

Tough, realistic training is the key to readiness. Emphasis on training will continue to focus on fully integrating engineers into the combined arms team. Force realignment will progress further toward placing the engineer regiment as the organic support for a maneuver division. The Army Reserve and National Guard will continue to experience realistic integrated training. They will train more frequently and vigorously with their Active Component partners.

Within the resource constraints of a leaner, more battle-focused Army, a trend toward MOS consolidation will continue. Wherever two similar functions exist under different occupational specialties, the two will be merged, if possible. This will require individual soldiers to function in a broader variety of roles.

On the AirLand Battlefield of the future, engineer leaders must be quick thinking, flexible, and creative to provide dynamic support to the maneuver commander. Engineer support is a combat multiplier, but only when it is correctly focused. Development of these engineer leaders begins with early identification of leadership strengths and weaknesses; during the Engineer Officer Basic Course (EOBC) for officers, and the first assignment for enlisted personnel. Assessment of soldiers' actions during rigorous, realistic, combat-oriented training will indicate who leads and who follows.

Leaders will assume responsibility for portions of their professional development. Beginning in the next decade and refined into the next century, NCOs will be tested annually with the new self-development test (SDT). The SDT will consist of technical, leadership, and training questions. As with the old skill qualification test (SQT), the technical questions will come from the soldier's manual. NCOs will be required to prepare for the SDT on their own time.

Officers will be trained to doctrinal and technical proficiency using the military qualifications standards (MQS) system. This system will provide a common ground for training our officers as part of the combined arms team. As with the SDT, the major responsibility for maintaining technical and tactical proficiency will rest with the individual soldier.

Engineer warrant officers will continue to fulfill critical roles in engineer maintenance and utilities management. Our warrant officer population for all technical skills will be developed from experienced enlisted soldiers in related fields who have appropriate military and civilian educations. But most importantly, all will be required to expand their troop leader role. No longer just a technician, the engineer warrant officer will be a leader first, then a technician.

Leadership opportunities from squad leader to regimental command will not suffer under the engineer restructuring. In fact, in the engineer force 2000, leadership opportunities will be at least as good proportionately, if not better in some grades. Even in the leaner, lethal force of the future, chances for assignment to a troop-leading position for both enlisted and officer personnel should match current opportunities. Accordingly, resident school selections, promotion rates, and unique leadership opportunities will be as good or better than current levels.

The focus in the year 2000 will be on individual professionalism, with an emphasis on self-improvement. A more lethal, technical, contingency-based force will require an intelligent, flexible, and innovative Army of leaders. The proficiency of the force will improve, not as much by a designed training program, but more by natural development of our professional leadership cadre.

Combat leaders, and that is what all engineers are, must be proficient in the basics of soldiering. Engineers at all levels must be proficient in weaponry and technical skills, confident in their battlefield leadership abilities, and competent in their design and management techniques.

Proficiency, demonstrated competence, and performance will be rewarded through selection for schools, promotions, and command leadership positions.

However, with the reduced force structure, subcaliber performance will be quickly culled out. The resulting cadre will truly be the best engineer force America can field.

A Final Thought

Through progressive leader development, with ethics and integrity as the bedrock, unselfish service to the nation will be instilled throughout the Regiment. Then, should the need arise, we will have produced for the country the new Putnams, Lees, Fremonts, Warrens, MacArthurs, Groves, and Itschners when strong, competent leadership is required in challenging positions of leadership.

> *"If we learned nothing else from the recent operations in Grenada and Panama, we have learned that soldiers fight exactly as they are trained in peacetime. We must command in peacetime as we command in war. We must place the same responsibilities upon subordinates in peacetime that we expect of them in combat."*
>
> *General John W. Foss*
> *Commanding General,*
> *Training and Doctrine Command*

Combined Arms Breaching

By Captain James R. Brannon

Breaching is one of the most critical engineer missions on the battlefield. Advances in mine technology, debate over breaching methods, and a continuing real-world threat—like that recently posed by Iraq—all combine to make breaching a hot topic among engineers.

Well, take note, because FM 90-13-1, *Combined Arms Breaching Operations,* is finally on the street. Breaching operations, particularly during tactical maneuvers at the National Training Center (NTC), have been under intensive study by the Engineer School for the last two years. This article describes that study, and its impact on our breaching doctrine. A 1988 study conducted by then-Lieutenant Colonel Robert J. Greenwalt, from the Engineer School's Department of Combined Arms, has been replicated and verified in a follow-up study completed by the School's Directorate of Evaluation and Standardization (DOES). The purpose of this follow-up study was to complete the work started by LTC Greenwalt as an on-going part of NTC Engineer Trendline Analysis. This summary will present the inal conclusions of those studies and a brief overview of tested and verified doctrine for combined arms breaching.

Study Conclusions

Our combined arms breaching doctrine is sound, it works, and has been field-verified at he NTC in more than 100 battles. The proper applica-ion of our breaching doctrine virtually assures a successful breach. Study confirms that units which cor-ectly employ proper doctrine succeed. Those that do not—fail. It cannot be overemphasized that your best assurance of success in breaching is proper application of our new doctrine.

Using METT-T (mission, enemy, terrain, troops and time available), an IPB (intelligence preparation of the battlefield) process with sufficient detail, good reconnaissance, combined arms team rehearsal, and synchronization of forces and SOSR (suppression, obscuration, security and reduction) are central to that doctrine. Commit the fundamentals of breaching doctrine (page 11) to memory and file it in your "smart book."

Time and experience shape doctrine. But once put on paper, few components of the military art are as challenging to test and validate as doctrinal concepts. Solid, quantifiable evidence often does not exist. But perhaps the greatest challenge is the acceptance of doctrine by those who stand to benefit from it. Revised methodologies, especially when they differ from former, more familiar ways of doing business, are often viewed with suspicion. This natural reluctance to change must be met with clear and convincing evidence.

Research

In 1988, LTC Greenwalt reviewed the results of 47 battles fought at the NTC during FY 1988. The DOES conducted a similar study of 56 battles which took place during FY 1989. Each of these studies compared the application of combined arms and engineer breaching methods with the outcome of breaching operations. The results of the study, reported at the Engineer Commanders Conference in

May 1989, examined these trend issues: reconnaissance of obstacles, templating of obstacles, rehearsal of breaching obstacles, breaching doctrine application, and breaching equipment.

LTC Greenwalt's study surfaced conclusions that were both interesting and alarming. First, doctrine was applied only 25 percent of the time in combined arms breaching of obstacles. Not surprisingly, 72 percent of the breach efforts fell below standards and 57 percent failed at the obstacle. The standard used in his study was 30 minutes effort, with light casualties. This should not be construed as "the" standard, but it was used as a point of departure for classifying various breaching operations in the study.

Secondly, the application of breaching doctrine resulted in an 80 percent success rate. Those parts of doctrine contributing most to successful breaching were:

- Rehearsal of combined arms team with engineers (100 percent successful).
- Application of breaching fundamentals (SOSR) (80 percent successful).
- Reconnaissance of enemy obstacles (75 percent successful).

These results come as no real surprise. It should be noted that this particular order of merit was not fully conclusive in the 1988 study. However, the very same observations were repeated in the 1989 DOES study.

While breaching doctrine was being reviewed and FM 90-13-1 was being staffed, DOES set out to replicate the original 1988 study. The purpose of our study was to clarify, confirm and complete the observations of the earlier study, to examine the use of doctrine and the effects of using it, to determine the interrelationships between doctrinal elements (if any), and to attempt to build a regression equation that would permit prediction of battle success.

The 1989 study director was Dr. William Dannenmaier, chief of the DOES analysis division. Study team members were Captain Neal Lovell and Captain Anthony Bailey.

The 1989 DOES study confirmed what LTC Greenwalt had discovered. Doctrine for combined arms breaching operations is employed less than half of the time at the NTC. When doctrine is employed, breaching operations are successful. When doctrine is not used, units are very likely to fail. Shadowing the 1988 study, it was found that those elements of doctrine most critical to successful breaching operations are (in order):

- Application of breaching fundamentals (SOSR).
- Organization for the breach.
- IPB (specifically, reconnaissance and templating).
- Combined arms team rehearsal (with engineers).

The 1989 study applied some sophisticated analysis techniques in an attempt to find correlations between the application of doctrine and success in breaching. Using a nine point scale (nine being highly successful and one being total failure), five points was established as the threshold for successful breaching operations.

All breaching operations were classified first by subdividing them into three categories (poor, average, and successful), and further dividing each of these again into three categories (poor, average, and better). Using a modified Delphi technique, scores were assigned to breaching operations based on the descriptions contained in NTC take-home packages.

After classifying each breach operation, the breaching doctrine employed in each battle was type-classified as either present or not present (assigned a score of one or zero). This allowed the construction of a matrix and the calculation of correlation coefficients between doctrinal procedures and battle success.

Using multiple regression analysis, regression weights that describe the contribution of each component of breaching doctrine were determined. The regression weights computed in the study are shown in the following table:

Item of Doctrine	***Weighting Factor***
1. Application of SOSR	2.54
2. Organized for breach	0.93
3. IPB/templating	0.93
4. Combined arms rehearsal	0.53
5. Reconnaissance	0.05

The usual model employed in multiple regression is an equation that attempts to relate some event (in this case breaching success) to some orderly collection of independent events. Normally, we see this equation as:

Outcome = Constant + Contribution from event 1 (2, 3 and so on)

The constant in this expression represents the minimum expected value for the predicted outcome, given that all contributions from each event are zero. Beyond that description, the constant has no real meaning. The weights from the table may be used in a simple prediction equation with a constant of 3.04.

Breaching Doctrine

- ***Intelligence:*** Perform an IPB (intelligence preparation of the battlefield) with terrain analysis, enemy doctrinal templates, situational templates with enemy obstacles noted, and finally a decision support template. Include an engineer squad with the task force reconnaissance platoon. Understand how the IPB process works and exploit every opportunity to know the battlefield. You must know what to expect and how to counter it in order to maintain your initiative and capitalize on any opportunities.
- ***Breaching Fundamentals:*** Suppress, obscure, secure, and reduce (SOSR) (Figure 1). Understand what these terms mean and make sure your actions are coordinated and synchronized with these key activities. Breaching actions performed by the maneuver forces cannot succeed unless you are aware of the total plan of fire support, the movement through the obstacle and to the objective, the needed lanes through the obstacle, when and where obscuring smoke is placed, how long it will last, and how you can get more. Securing the far side is key to effectively breaching any obstacle; you must know how this will happen, who will do it, and what engineer forces will go forward. Far-side security provides protection and time to reduce the obstacle to support the task force scheme of maneuver.
- ***Breaching Organization:*** Support force, breach force, and assault force. Are you prepared to react and reorganize to breach different types of obstacles? When will the support force be in place? What sector of fire or avenue of approach will they cover? Who's in charge? When and where will you meet?
- ***Mass:*** Crack the obstacle, rupture the defense; find a weakness or create one. You must open enough lanes to push sufficient maneuver forces to the far side (Figures 2 and 3). Doctrine calls for a minimum of two lanes per task force. Mass enough engineer force against the obstacle to reduce it using multiple techniques. To prepare, make this part of your engineer estimate. What resources will you need to open two, three, or four lanes? Where and when will you get them? How will you replace casualties and continue to press the fight?
- ***Synchronization:*** Plan, practice, and execute the synchronization of SOSR, support, breach, and assault forces (Figure 4). Rehearsal is key. Can you find the obstacles under cover of smoke? Do your soldiers know what to do, can they move quickly? Will they confuse enemy artillery with friendly artillery suppressive fires? Do they know where to go after breaching, who links up and where? Timing is critical, you must plan thoroughly to make it happen the way you want it. Start with the reverse planning process: the actions at the obstacle must support the actions on the objective. Which squad or team moves to the objective with the maneuver forces, what is their mission, who will lead them? You must know in advance how you are going to get your soldiers to where you want them to be and when they must be there. It takes a lot of tough thinking. (See Chapter 2, FM 90-13-1)

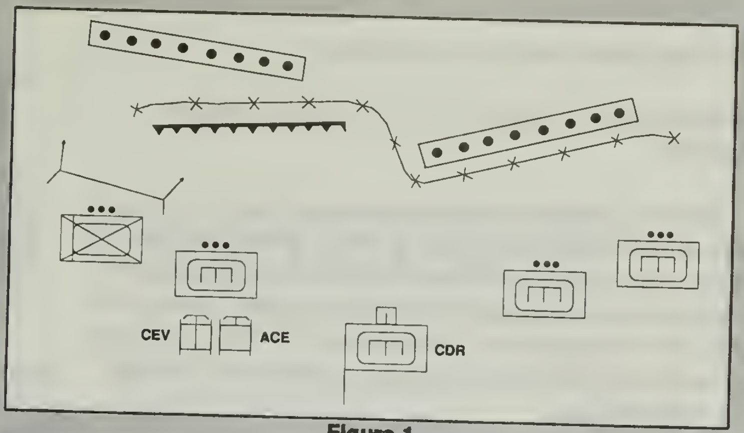


Figure 1

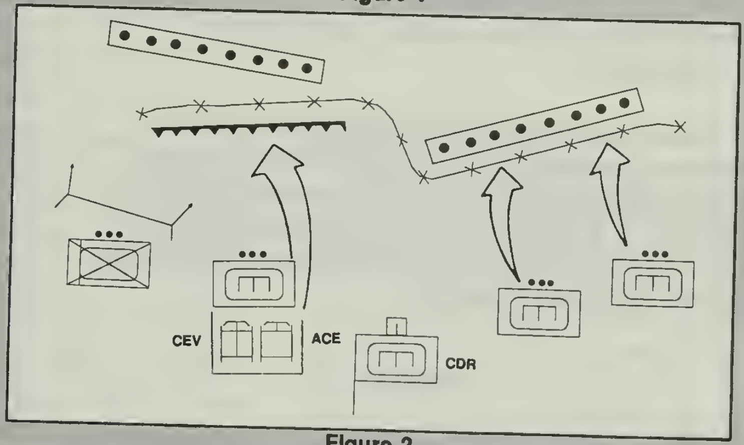


Figure 2

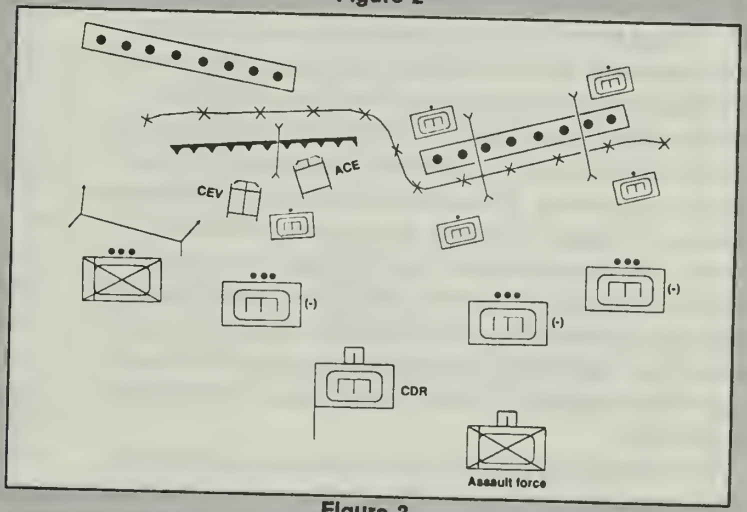


Figure 3

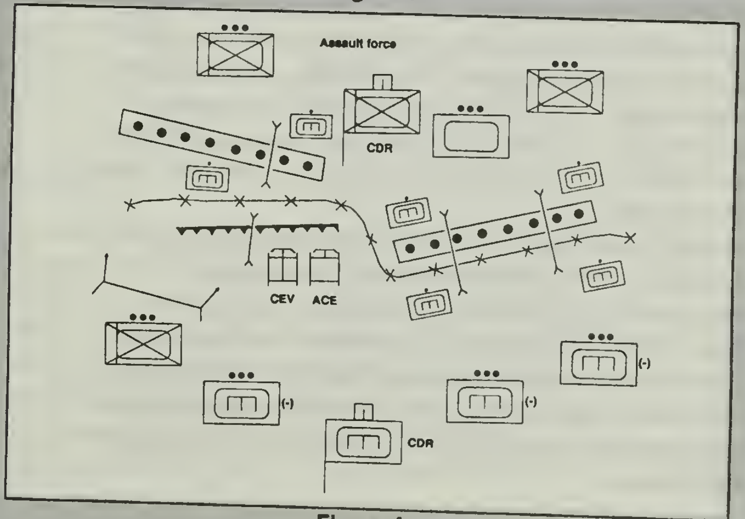


Figure 4

This equation may be expressed as:

$$\text{Breach score} = 3.04 + (\text{sum of doctrine weight factors})$$

Developing this prediction equation was one objective of the study. The more doctrine employed, the higher the score. A score of near 8 was classified as representing successful multiple breaches. Using the prediction equation and employing all of the elements of breaching doctrine, a breach score of 8.02 would be calculated as:

$$\text{Score} = 3.04 + 2.54 + 0.93 + 0.93 + 0.53 + 0.05 = 8.02$$

We can simply add the contribution weights because we ascribed a score of zero or one to each doctrinal element (either the doctrine was used or it was not). It is important to note that the weights (regression coefficients) were determined from evaluation of the interrelationships.

Insight

Hard data were scarce, and the DOES study had to make some reasonable assumptions. Foremost was the assumption that breaching at NTC is sufficiently real to validate doctrine for the battlefield. Also, it was assumed that after action reports (AARs) from the NTC accurately reported exercise results. Of course, the study was limited to NTC rotations in FY 89 and also by the degree of detail in AARs. These assumptions and limitations became less of a concern when the 1989 study independently confirmed the observations made in 1988, and supported the significant, unsolicited feedback from subject matter experts, observer/controllers, and others at the NTC.

In the two years of study concluded by DOES, we found answers to many important questions. The essence of the research was to determine what impact combined arms breaching doctrine had on the outcome of breaching efforts. Admittedly, doctrine is not a lock-step, by-the-numbers application of isolated procedures. The fact that breaching can require just as much art as science made the analysis very challenging.

Part of the analysis required researchers to examine doctrinal interrelationships and make reasonable judgments regarding the strength of those relationships and their impact on the execution of a breach. Fortunately, the tools of analysis (regression and correlation) produced results with a high margin of confidence that was statistically significant.

Conclusions

The battlefield is a highly unpredictable place. This study does not claim to set in concrete any type of cause and effect relationships. It does, however, help formulate reasonable conclusions. The range of possibilities runs from a highly successful breach employing no doctrine at all, to a completely failed breach employing all doctrinal elements.

What we are concerned with are the probabilities, the actual likelihood of events. The importance of this study is that it quantifies those likely events into reasonable form.

The facts of the study are fairly clear. Breach failures at NTC were conspicuous by their lack of sound doctrine. Successful breaching operations were consistently characterized by the application of breaching doctrine. The strength and reliability of these characterizations is the real essence of the numerical analysis. The numbers tell us that properly applied combined arms breaching doctrine is highly effective.

While the DOES study confirms that our breaching doctrine is sound, the "fog of war" provides unpredictable variables that can never be tested or quantified. It's often said that "no plan survives the first enemy contact." What happens to you when you attempt a breach under fire cannot be predicted by any study or any equation.

What the study does prove, however, is that you can stack the odds in your favor by correctly employing breaching doctrine.

Captain Brannon is senior analyst for the Engineer School's Directorate of Evaluation and Standardization. He previously served as a company commander with the 34th Engineer Battalion. He is a graduate of Combined Arms and Services Staff School. He holds a degree in civil engineering from the University of Texas at Austin, and graduate degrees in Business Administration and Systems Management from Boston University and the University of Southern California, respectively. He is a registered professional engineer in Texas.

Engineers and Combined Arms Training Strategy

For years, a method of ensuring that engineer units conduct integrated combined arms training has been high on the wish list of many commanders and training officers. A way was also needed to outline the methodology used to determine engineer training strategies and the resources required to support them.

The Army's answer to this need is the Combined Arms Training Strategy, or CATS for short. CATS is designed to provide an "executive summary" of master plans for training. The summary provides a link between combat and combat support units, institutional and unit training, and individual and unit training.

Background

CATS is an evolving strategy designed to capture, on one document, the effect of the Army's current and future training requirements for unit training. The new strategy provides subordinate units with guidance on developing annual training calendars. CATS is the Engineer School's recommended model for keeping an engineer unit within the band of excellence described in FM 25-101, *Battle Focused Training*. CATS outlines the recommended training frequencies and the resources needed to support them.

The CATS concept evolved from a 1988 tasking from Army Chief of Staff General Vuono to Training and Doctrine Command (TRADOC). TRADOC was given the task of developing a strategy to train the entire Army to operate effectively as a combined arms force. For strategy developers, "combined arms" meant the integration of active and reserve forces, and heavy, light and special operations (SOF) units. The strategy would serve as the driving force for defining, developing and managing training and training resource requirements.

The Combined Arms Center, Training (CAC-TNG) at Fort Leavenworth is charged with integrating the CATS strategies vertically from higher to lower headquarters. They are also responsible for ensuring that the strategies are coordinated horizontally between combat arms, combat support and combat service support units.

Structure

Unit and institutional training strategies are the two major components of CATS. Since institutional strategies are still under development, this article deals primarily with the former. The institutional side of CATS is briefly covered at the end of this article.

The unit training strategy consists of three baseline strategies: maneuver, gunnery and soldier. These recommend the type and frequency of training events that will allow units to stay proficient. The three strategies are also configured to allow flexibility for current resource constraints.

As the CATS program matures, the Engineer School will develop "projected" strategies in an effort to meet future training and resource requirements.

Maneuver

The four engineer maneuver training strategies now in place are listed at the top of page 14. A fifth strategy for engineer groups/brigades is also being developed. Those units which do not have a strategy, like specialized detachments and separate companies, will use the strategy of the engineer unit to which they are attached.

The unit maneuver strategy for the Combat Engineer Battalion, Wheeled/Mechanized, is shown at Figure 1, page 14. Each unit, from individual crews to the whole battalion, are matched to specific training events. These include command post exercises (CPXs), situational training exercises (STXs), and field training exercises (FTXs). The STXs and FTXs

By Captain Robert Kurtz & Captain Chris Nolta

Maneuver Training Strategies

Engineer Battalions, Wheeled/Mechanized
Engineer Battalions, Light/Airborne/AirAssault
Engineer Battalions, Combat Heavy
Engineer Battalions, Topographic
Engineer Groups/Brigades

found in each unit maneuver training strategy are tied to the sample STXs and FTXs found in ARTEP (Army Training and Evaluation Program) mission training plans.

Each training event is considered a separate activity. All events emphasize the training of engineers for their role in supporting a maneuver task force. The training event frequency for the engineer company/platoon, for instance, calls for participation in "engineer-only" company exercises as well as maneuver brigade/battalion exercises. Distinctions are also made between Active and Reserve Component training.

Critical gates are identified at the bottom of each event column. These gates require units to train tasks using a low-cost event, like a drill, before attempting to train at a high-cost event, like a field training exercise. Requiring successful completion of the task at a low-cost event reduces the possibility of poor performance at a high-cost training activity. Obviously, this gives the Army—and the soldier—more proficiency for every dollar spent on training.

An example of a critical gate is requiring the crew of a combat engineer vehicle (CEV) to successfully fire the 40 millimeter (mm) subcaliber device before conducting live fire with full-size rounds. Another example is preliminary marksmanship instruction (PMI). This is basic rifle instruction which soldiers must pass before weapons qualification on a firing range.

Critical gates will allow commanders to better analyze and judge the combat readiness of their units. The gates will ensure that soldiers know the basic skills for tasks before undertaking time-consuming and costly training events.

For each unit maneuver strategy, the resources are broken down into three tables: OPTEMPO (operating tempo), ammunition, and TADSS (training aids, devices, simulators, and simulations).

OPTEMPO mileage figures are taken from the battalion level training model (BLTM). Because a unit strategy can apply to more than one type of unit (i.e. light infantry, airborne, air assault), and OPTEMPO figures apply to single units, a "base" OPTEMPO was selected for each unit strategy.

Since a number of different

COMBAT ENGINEER (WHEELED/MECH) MANEUVER STRATEGY

ARTEP 5-145 MTP SERIES

EVENTS / LEVELS		DRILL	MAPEX	TEWT	CELL TRNG	TOCEX	STAFF EX	CPX	STX	LCX	CFX	DEPEX	FTX	EXEVAL CTC	OTHER
CREW	AC RC	12 4													
SQUAD	AC RC	12 4							12 2						
SECTION	AC RC														
PLATOON	AC RC		12 2	8 2				4 1	8 2		6 0.5		4 1	1 0.25	
COMPANY	AC RC		12 2	4 1		4 2		4 1	6 2		2 0.5		2 1	1 0.25	
BN	AC RC		12 2	3 1	WKLY 4	4 2	12 2	4 1		4 0.5		6 0.5	2 1	1 0.25	
CRITICAL GATES							CELL TRNG	STAFF EX	DRILL		STX		STX	FTX	
RESOURCES															
OPTEMPO		X				X			X		X		X	X	
AMMO		X							X		X		X	X	
TADSS		X	X	X			X	X	X		X		X	X	
LAND		X				X			X		X		X	X	
RANGES															
OTHER															

ANNUAL EVENT FREQUENCIES ARE DESCRIPTIVE, NOT PRESCRIPTIVE. FM 25-101 DEFINES EVENTS.
COMMANDER'S ASSESSMENT, UNIT METL, AND AVAILABLE RESOURCES DICTATE ACTUAL FREQUENCIES.
STRATEGY RECOMMENDS TRAINING MIX TO STAY WITHIN BAND OF EXCELLENCE (FM 25-101).

Figure 1

COMBAT ENGINEER BATTALION (MECH)
COMBAT ENIGNEER VEHICLE (CEV) TRAINING STRATEGY

GUNNERY

LEVEL AC/RC	MOS TASKS	GST	DRILL	CRT	OPS TEST	ZERO & TBL 1-V	LFX	CALFEX
Individual	DAILY/ MONTHLY	4/2						
Crew		4/2	12/4	4/1	2/1			
Squad				4/1	2/1			
Platoon						2/1	1/.25	1/.25
Company								
Battalion								
Critical Gates		MOS TASKS	MOS TASKS	DRILL	DRILL	GST & CRT	TBL 1-V QUAL	LFX

RESOURCES

OPTEMPO Base: M113	LTA/ GARRISON	LTA/ GARRISON	LTA/ GARRISON	LTA/ GARRISON	LTA/ GARRISON	48 MILES	48 MILES	24 MILES
Ammunition	NOT REQ'D	NOT REQ'D	NOT REQ'D	NOT REQ'D	NOT REQ'D	165MM TP/ SUBCAL	165MM TP/ SUBCAL	165MM TP/ SUBCAL
TADSS/Equipment						M970 CEV SUBCAL	M970 CEV SUBCAL	M970 CEV SUBCAL

TC 5-117 PROVIDES TRAINING METHODS AND QUALIFICATION TABLES.
DA PAM 350-38 PROVIDES CEV AMMUNITION ALLOCATION.

Figure 2

tasks can be trained in each event, ammunition requirements cannot be tied to events. STRAC (Standards in Training Commission) provides ammunition allocation by task. Commanders must determine ammunition requirements based on the types and numbers of tasks to be trained during an event. They must also carefully manage their ammunition to meet the frequencies recommended in the gunnery model.

TADSS developed by the Engineer School and other branch schools are also incorporated into the strategies. Also included are TADSS currently in the system and those that are in different stages of production.

Gunnery

The second of the three baseline unit strategies is gunnery, which is broken down by weapon system. The Engineer School has developed gunnery strategies for the CEV, mines and demolitions. These strategies are tied to DA Pam 350-38 (STRAC).

Engineer units will also use weapons strategies developed by the Infantry School. That school is the proponent for small arms, machine guns, grenades, claymores, and antitank weapons systems.

Figure 2 shows the gunnery strategy for the CEV. Like maneuver strategies, all needed information is identified, including the unit conducting the event, the event, frequencies, critical gates, and resources. Several of the events identified for the CEV, like the gunnery skills test (GST) and the combat readiness test (CRT) are taken from TC 5-117, *CEV Operations*. This manual also provides training methods and qualification tables for the CEV.

Soldier

The last of the three training strategies is for the engineer soldier. Strategies have been developed for the three engineer career management fields (CMF). The Engineer School is responsible for CMF 12, combat engineer; CMF 51, general engineering, and CMF 81, topographic engineering.

Figure 3, page 16 shows the engineer soldier training for the CMF 51 field. The subject areas in which the soldier should be proficient are listed across the top of the chart, and the training frequency is listed down the left side.

Institutional Strategies

Institutional strategies are still in the developmental stage, and first drafts are scheduled for completion later this year. When finished, these strategies will allow the Engineer School to provide training that is more likely to help soldiers once they arrive in their units. For instance, soldiers will receive more institutional familiarization with training aids and devices commonly used by line units.

These strategies are being developed for the engineer officer basic (EOBC) and advanced courses (EOAC), advanced noncommissioned officer course (ANCOC), basic noncommissioned officer courses (BNCOC), and the advanced individual training courses (AIT). Follow-on CATS development may also include work on a strategy for the

ENGINEER SOLDIER TRAINING STRATEGY — CMF 51

EVENT / FREQ	PHYS TNG	CTT	MOS	MAINT TNG	WPNS TNG	DRVR TNG	CMT	NBC TNG	LAND NAV	PROF DEV
DAILY	A		A	A						
WEEKLY		A						A		A
MONTHLY			R	R	A				A	
QUARTERLY		R				A		[A] R	R	R
SEMI-ANNUAL	[A]				[A] R	R				
ANNUAL	[R]	[A]	[A]		[R]			R	[A,R]	
BIENNIALLY		[R]	[R]							
AS REQUIRED	R			[A,R]		[A,R]	A,R			
RESOURCES										
OPTEMPO						60				
TADSS		X	X		X			X	X	
OTHER										

A = ACTIVE COMPONENTS R = RESERVE COMPONENTS
[ ] = TESTING FREQUENCY (i.e., APFT, SDT, etc.) CMT = COMMON MILITARY TRAINING (TABLE 4-1, AR 350-1)
SDT = SOLDIER DEVELOPMENT TEST FOR MOS TRAINING APPLIES TO SKILL LEVELS 2, 3 & 4
IF NO STANDARD ARMY TEST EXISTS FOR A TRAINING EVENT (i.e., MAINT TEST, NBC TEST, ETC.), DEVELOP A UNIT TEST.
REFER TO THE APPROPRIATE GUNNERY STRATEGY FOR ADDITIONAL WEAPONS TRAINING GUIDANCE.

Figure 3

engineer portion of the pre-command course (PCC).

The Future

As the CATS program expands, "projected strategies" will be developed for the maneuver, gunnery and soldier areas. These project strategies will attempt to forecast training and resource requirements by looking 5 to 10 years into the future.

These projections will reflect the influences of a changing threat, new technology, budget, and mission. They will also keep an eye on changes in the linkage between institutional and unit training, and will facilitate the development of acquisition plans for training resources.

TRADOC envisions that CATS will become a decision support software module in the existing Standard Army Training System (SATS) software package, fielded in FY 90. This software will manipulate a data base containing training resources and training requirements, and will assist in the development of unit training calendars. It will also help in determining resource requirements, and coordinating the appropriate mix of training instruction and materials. An initial concept of the automated baseline strategies is expected later this year.

Once automation is completed, CATS will function simultaneously on several different levels within the Army. It will operate in units on the ground, in the TRADOC and AMC (Army Materiel Command) development process, with DA resource planning, and with field army planners.

Education and information programs for CATS users are now in the works. CATS classes will soon be included in PCC, EOAC and EOBC instruction. Briefings are planned for major command conferences, as well as engineer commander's conferences.

Articles like this one will also serve to get the word out on the new system. In the future, unit strategies will be included in appropriate ARTEP mission training plans.

Unit training can be affected by a seemingly infinite number of things, including institutional training, individual command direction, material developers, and material resourcers. CATS allow leaders to get a clearer picture of how all of these influences work together—or, sometimes, against each other. Only then can they determine where we are going, and what we need to do to get there.

Captain Kurtz is a training analyst with the collective training branch of the Engineer School's Directorate of Training and Doctrine. He previously served as assistant S-3, company executive officer, and platoon leader with the 16th Engineer Battalion. He is a graduate of the Engineer Officer Advanced Course. He holds a degree in civil engineering from Purdue University, and a master's degree in civil engineering from New Mexico State University.

Captain Nolta is a training analyst with the collective training branch of the Engineer School's Directorate of Training and Doctrine. Previous assignments include platoon leader and division engineer liaison officer for the 12th Engineer Battalion. He is a graduate of the Engineer Officer Advanced Course. He holds a degree in management from Virginia Polytechnic Institute.

MOS Qualification

in the Pacific

By Captain William E. Bowers

Soldier proficiency is the backbone of Army combat readiness. A trooper skilled in his military occupational specialty (MOS) is a full member of the fighting team. Unfortunately, attaining that proficiency can sometimes be tough for Reserve Component soldiers.

Active duty engineer units receive soldiers who have graduated from basic and advanced individual training (AIT). These soldiers are fresh from intense training in fundamental MOS skills.

A large portion of reserve strength, on the other hand, comes from prior service soldiers with reserve service obligations. Often, units do not have duty positions that match an incoming soldier's prior MOS. And this doesn't help the soldier because qualification in the Guard and Reserve is based on duty MOS. Resident attendance for AIT at service schools is often not an option because it usually conflicts with the reserve soldier's full-time job.

The result is a significant number of soldiers in Reserve and Guard units who are not fully qualified in their duty MOS. Travel time and distance compound this problem for overseas units located in Hawaii, Guam and Alaska.

The 411th Engineer Battalion (CBT-HVY), a Reserve unit stationed in Honolulu, Hawaii, came up with their own solution to the problem.

The 411th, like many other Reserve Component units, was having difficulty maintaining its combat readiness because of a shortage of MOS-qualified soldiers.

A soldier from the 411th Engineer Battalion, an Army Reserve unit from Hawaii, drives a roller during the unit's MOS training program. The unit found an answer to its MOS training problems by using a mobile training team from the Engineer School.

Of particular concern were high-density specialties like carpenter (51B), construction equipment operator (62E), and general construction equipment operator (62J).

The battalion's solution to the MOS shortages centered around the use of mobile training teams (MTT). These teams, manned by service school instructors, travel to a unit's home station to teach designated courses. Equipment and assistant instructors are provided by the host unit.

Knowing that there was no foreseeable end to the shortage of carpenters and equipment operators, the battalion began planning for MTT assistance about a year before classes were held. The 411th, in conjunction with the 4960th USARF school in Hawaii, and the Army's Western Command (WESTCOM), requested instructor support from the Engineer School at Fort Leonard Wood. The MTT plan called for instruction to take place during the unit's two weeks of annual training in June 1990.

Since mobile training teams had never been used for MOS certification in Hawaii, planning had to begin from scratch. Further complicating matters, the 62J course had never been validated for MTT instruction.

The Engineer School provided the battalion and the USARF school with copies of the MOS programs of instruction (POI). Each POI outlined the type of training that had to be completed, and the standards which had to be met. It was then up to the battalion to develop an annual training schedule that would fulfill all of the POI requirements within the available 14 days.

Training support was no simple task. More than $16,000 worth of lumber and construction materials was purchased for carpentry training. Part of South Range at Schofield Barracks was reserved to provide a training area for the equipment operators. The battalion also provided all organic tools and equipment for the course.

Nearly 70 students were trained during the two-week period. NCO instructors from Pacific-based units augmented the instructors from Fort Leonard Wood.

To make maximum use of the MTT, the 411th invited other Pacific-area units to the training. In addition to 45 students from the 411th, Alaska's 813th Engineer Battalion (CBT-HVY) sent 13 students, and Guam's 297th Engineer Company (CBT-HVY) sent six.

Finding enough instructors to teach such a large group required close coordination. Funding constraints limited the size of the Engineer School's MTT to no more than five instructors. The recommended instructor-to-student ratio was approximately one to five. Because the USARF school in Hawaii did not have enough qualified instructors to adequately augment the classes, a decision was made to train Pacific-based engineer NCOs to teach the material.

The 84th Engineer Battalion (CBT-HVY), an active duty unit stationed in Hawaii, provided four NCOs to be trained as instructors. The 411th provided six personnel, and the Engineer School was able to send four instructors. This cooperative effort marked the first

For engineers taking part in the training, each day began at 5 a.m., and ended about 6 p.m. Students worked through the weekends, and remedial work was conducted at night.

time that the Engineer School, an active duty unit, and a Reserve Component unit joined together to conduct an MOS-qualifying school.

The limited time constraints for the classes meant that a no-nonsense schedule was absolutely necessary. The training day began at 5 in the morning and finished about 6 in the evening. For soldiers who required remedial work, the training day was extended into the night. There were no weekend breaks, and no time off for the students' personal affairs.

The typical training day normally began with a short period of classroom instruction. This provided the students with the basic principles and concepts that would be put into practice later in the day.

Training for the carpentry students centered around the construction of 15 foot by 15 foot wooden buildings with gable roofs. Students were broken down into groups of six. Each of these groups was assigned an instructor, and given the mission of constructing a building, complete with doors and windows. Training included preparation of the building site, floor and wall construction, and installation of the roof, doors and windows. Also included was instruction on building walls with concrete masonry unit (CMU) blocks.

Equipment operators were given the opportunity to work with all heavy engineer equipment. These students were also divided into smaller groups, and given instruction on proper operating procedures and maintenance requirements. Along with practice in using the equipment for a single task, students were taught how to work as team members. For instance, one student would operate a 20-ton dump truck, while another used a bucket loader to fill it.

The hard work paid off. All students completed the course, and the 411th's MOS qualification status was improved by more than 10 percent. In addition to providing soldiers with valuable training, the classes presented a significant cost savings to the Army. Training by other methods would have cost an estimated $30,000 in additional travel expenses. And because students lived and worked out of general purpose medium tents, billeting expenses were minimal. Special funding for the soldiers' salaries was not necessary because the classes were given during regular annual training.

A key to the success of this particular program was the establishment of a strong working relationship between Active and Reserve Component units. In these times of reduced budgets, training efficiency is a must—even when unit location makes it difficult to maintain soldier proficiency. Mobile training teams are a good way for many reserve units to beat the MOS qualification problem. The 411th and the Engineer School proved it can work.

Captain Bowers is the engineer branch chief for Army Readiness Group-Pacific. He is a West Point graduate, and holds a master's degree in mechanical engineering technology from Northern Illinois University. He is a graduate of Command and General Staff College.

An Interview With:

Major General Daniel R. Schroeder,

Commandant of the Engineer School

Interview by Phil Howell
Features Editor, ENGINEER Professional Bulletin

ENGINEER: *The Army is facing significant changes in its size, structure and the role it will play in world affairs. What are your views on those changes, and how do you think they will affect engineers?*

MG Schroeder: The strategic setting in which the Army operates is changing dramatically. When you look at the changes that are taking place in the world, the emphasis has been on central Europe. The end of World War II is what you're seeing.

For the last 45 years, we've had the Army fully deployed and demonstrating its capabilities with great resolve. I think that's contributed significantly to the changes you see taking place in central Europe and the Soviet bloc. Especially during the past decade.

The Total Army has demonstrated its resolve by standing fast in the face of certain threats and some ambiguous circumstances. And its demonstrated ability to do that evolved from good warfighting doctrine, a quality force, and tough, realistic training. So in terms of those world situation changes that are taking place, I think the Army has made a substantive contribution.

What do those changes portend for the Army? I think it's going to be a watershed period for the U.S. Army. As a result of those changes you now have budget pressures. The cohort, that is, the demographic population from which we draw soldiers, is getting smaller. Resources are getting smaller, and as a consequence you're going to find the Army getting smaller. But I think its strategic value to the nation is probably going to become more important as we enter into the 90's and get ready for the 21st century.

You're going to see a continued emphasis on forward deployed, or forward presence forces, and an increased emphasis on our ability to project forces to handle an unanticipated contingency. Lastly, you're going to see the requirement for us to have the capability to reinforce either the forward deployed or forward presence forces, or the contingency forces. One of the variants on that theme is the notion that you would have a reinforcement from a forward deployed force to a contingency force, not unlike what happened in Desert Shield/Desert Storm.

At the same time putting our work into the notion of "how do we shape the Army for the late 90's." That is, make it smaller, and yet preserve its quality and maintain its competence.

It's an opportunity for us to take a good healthy look at our doctrine, at our equipment, at our structure, at our development of young leaders, and at our training.

Traditional answers won't work. What's needed is a little creativity and good, intellectual thought toward the future, while at the same time keeping our feet on a sound historical foundation.

ENGINEER: *What has the move to Fort Leonard Wood done for the school's ability to train engineers?*

MG Schroeder: The environment itself, the opportunity to put those kinds of courses in a realistic setting—a more realistic setting than we enjoyed in other places, is the first marked improvement. We now have all the NCO courses here. We started bringing those up in early 1988. The first warrant officer course was graduated from here in October 1988. The first officer course started here at Leonard Wood in January 1990.

Another plus is having the noncommissioned officer and the officer share in the same climatology, if you will, as the one-station unit training soldier. To be able to see those initial-entry soldiers receiving training on very fundamental engineer skills has been an enhancement in terms of the socialization of our engineer leaders.

I think the real payoff has been the shared training that we're exploiting. Taking the Basic Officer Course, for example, and affiliating the course with one of the engineer training companies—letting lieutenants share an experience with a basic training company. For example, letting him learn how to administer physical training to a unit. Allowing him to see how basic rifle marksmanship is taught by a drill sergeant and an instructor, and then letting him receive the same training. Because when he becomes a platoon leader, he's going to have to do those things.

We then have the opportunity to take them out to our Normandy Training Area, where we teach them at three different stations: engineer skills like equipment, survey and road construction. We let our BNCOC students teach officers in the combat engineer vehicles—the M-9 ACE, the CEV, and others. That creates an interesting cultural exchange among those guys. BNCOC student feedback? Super! Their team leaders say they really had to do their homework. And the lieutenants say they got good instruction. Team leaders who oversee the entire process say the interaction between the two groups is superb.

Another advantage. Putting together the advanced course officers and the advanced NCO students on a tactical exercise, organized like a company. There, they both receive instruction at the same time on engineers in support of a task force in the offense, and engineers in support of the task force in the defense. Then they go out together and do a tactical exercise without troops (TEWT) on the ground, in our Crocker training area, where the problem is set. When these two groups of leaders can get together like that, sharing the experience of instruction on the same piece of ground, it gives us an absolutely super group of engineers.

We could never have done that before we moved to Fort Leonard Wood—but we do that now.

Commanders in the field are saying that they can tell the difference between a soldier that has received his training from Fort Leonard Wood, and one that has not. Especially in terms of his attitude toward authority and his sense of self-discipline. I think that's a reflection of the standards that our engineer trainers are upholding. The officers that we're graduating are better than any I've ever seen before—in terms of platoon leader competencies, and company commander competencies. Bottom line: we're producing good, solid performers.

"we'll keep focusing on the basic...skills..."
"I think if we continue to do that, our troops can meet any mission, anywhere, anytime."

ENGINEER: *You touched on the unification of Germany. About that time, there was a lot of talk about the "peace dividend," and reducing the size of our military force. Then Iraq caused second thoughts among some quarters. How quickly can the Engineer School adapt to the training and mission needs of engineers in the field? The switch from the plains of Europe to the Gulf War was pretty rapid.*

MG Schroeder: The ability to adapt to different challenges—the fundamental skills, the basic skills, the foundation of being a combat engineer—doesn't change. Doesn't change, except perhaps in some of the climatological or environmental applications like Desert Storm. Explosives are going to behave differently in a desert environment than they will in a very cold and moist environment. That not withstanding, the nature of how you emplace them, how you employ them, things of that nature—the principles are still there. Those principles are sound, we still teach those. So you've got a vertical hierarchy, if you will, of intellectual prowess that gets brought to bear in the training. At the basic skills level, we'll keep focusing on the basic, fundamental skills, blocking and tackling, if you will, and making sure our engineers are competent in all of them. I think if we continue to do that, our troops can meet any mission, anywhere, anytime.

ENGINEER: *So the formula for success is teaching engineers how to be good team members, good leaders, and giving them tactical and technical competence?*

MG Schroeder: That's right. And I think you find a manifestation of that in the different missions that they get over time. For example, you take a battalion into Honduras, into the central part of Honduras, and tell them, "Your mission for the next 120 days is to build a C-130 airstrip." That's not a very hospitable environment, in terms of its soil content, and its climate. And yet they've demonstrated their ability to do that time and again.

Again, good blocking and tackling. As you go up the vertical hierarchy, though, of those you train, the leader training and the leader development piece of that is what gives you the flexibility to do those kinds of disparate things. Taking engineer leaders, and building into their development the intellectual capacity to do the right kind of a mission estimate. What does it take to pull it off, what are the resources required. And that means making them technically competent, while at the same time teaching them the leadership piece of it that says, "You're going to have to be willing to take a risk, and to be bold as you provide advice to the maneuver command."

ENGINEER: *I've spent a lot of time in Latin America, and I've seen engineers build airstrips, roads, basecamps, schools, sewage and water systems, wells, and the list goes on. It seems to me that there was more than just engineering competence at work. The word "ingenuity" comes to mind.*

MG Schroeder: They thrive on that. The only time that engineer soldiers get in trouble is when you're not challenging them with hard work. But the ingenuity piece of it is the other part of the leader development that we're after here at the Engineer School. Often times, there are no stock answers to how you get the mission done. That's the kind of encouragement you want to give leaders as they grow and develop. And that involves inherent risk-taking. Being willing to put your judgement out there and be counted. Those are the kinds of things you try to inculcate in our engineers from the beginning of their careers.

ENGINEER: *Going back again to the subject of change. Could you tell us a little bit about changes in force development for engineers, and the new equipment they can expect to be using?*

MG Schroeder: To do that, you can't take the engineer piece in isolation. The engineer piece on the battlefield is part of the combined arms team. Where is the combined arms team going? I think what you're going to see is an azimuth that takes us to smaller, more agile—not just mentally, but structurally—agile forces. You can read that as maneuver capable forces—mobility warfare, maneuver warfare, non-linear warfare as it's described in some circles. And what that means, basically, is an increased reliance on strong command and control—make that "strong chain of command"—because command and control are really two separate things. Ingenuity and mental agility are key. We can't afford the attrition kind of fight anymore, so you've got to try to stay ahead of where he is, get inside his decision cycle. And I think you're going to see the maneuver forces going in that direction.

Now for the engineer part of that. Structurally, I think you see a greater move toward making the engineer piece a much more integral part of the combined arms team. For the first time, based on the work that we've done over the past year, we've got a good, solid analytic foundation as to what the right mix is, substantiated by good, rigorous analysis. And battle-focused on tasks. What that means, basically, is that no one organization is capable of doing all things for all people. Focusing the basic fighting element on maneuver and agility, and knowing that you have what you need to accomplish your mission. Being capable to pick that element up and move it, and apply its abilities over great distances.

For engineers, that translates into a battalion, a lean engineer battalion, a sapper battalion, per maneuver brigade. If you've got a three-brigade division, you then have an engineer regiment within the division, one battalion habitually associated, if not organic, to each maneuver brigade. Again, a lean battalion, focused on the mobility tasks. And what that means, basically, is good strong countermine/counterobstacle capability and assault.

ENGINEER: *How does "AirLand Battle-Future" fit into that?*

MG Schroeder: If you look at the evolution of things, AirLand Battle is our current doctrine today. It's the doctrinal concept of how we fight today. If you look to the future, you don't want to have to make a sudden leap into the future. You would rather have a steady evolving of thought and intellectual "grappling," if you will, in terms of what the doctrine should be in the future. AirLand Battle-Future is a natural evolution from the baseline of AirLand Battle that kind of bridges between where we are now and the next 20 years. You'd look out maybe 14 years and see the doctrine of AirLand Battle-Future being what you're after. You would see it addressing itself more than we do today to things like contingency operations, how you project power, conduct nation assistance, use the Army as a strategic instrument of United States policy. How do you structure the Army to accommodate those?

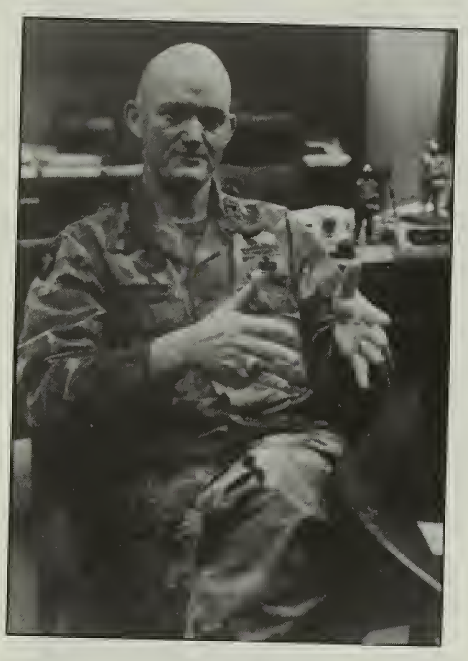
So I would say that AirLand-Battle-Future is an evolutionary step, and a logical step, as we get ourselves ready for the 21st century. What it says is that you are going to have a fight that is probably going to be done over large distances, with fewer units, on a less dense battlefield. And what that leads you to is the conclusion that battle is going to be very dependent upon maneuver. The traditional box lines—or layer cake—defense of things won't be applicable because you won't have the density to do that. And that leads you to the notion of nonlinearity in terms of what the next fights are going to be like. Not focused on terrain, but focused on killing the enemy, or destroying the enemy or his ability to prosecute the fight. It means taking advantage of technology—the ability to determine, from greater distances, where his major forces are. The ability to engage him at longer ranges with deep fires. And then using your maneuver forces in what you would look at as, I guess, the final step in completing the destruction of the enemy force. Then reconstitute and get ready to fight again.

ENGINEER: *Where are engineers in terms of having the equipment to be able to do that?*

MG Schroeder: A little bit behind. But the recognition of the requirement is being more and more strongly argued by maneuver commanders. When I say, "behind a little bit," it's things like the combat mobility vehicle (CMV). Super concept. It's key to the mobility of a task force, based on what the analyses tell us. And being able to maintain the momentum, keep the initiative. You've got commanders, to include the CINC of the Army in Europe, the CINC of Forces Command, former commanders of the NTC, being the ones who are now arguing for the force to have the CMVs. So it's not a parochial interest item as far as the engineers are concerned.

We're also looking at arguments for multiple purposes for the AVLB (armored vehicle launched bridge) carrier. Right now the AVLB is a one-dimensional carrier—it only carries the assault bridge. There's a notion out there that we ought to be able to fire the MICLIC, the mine clearing line charge, off the top of it. We ought to also be able to fire a VOLCANO (mine system) off of it, while we're buttoned up and on the move. Those kinds of flexibilities are what we're looking at, along with the versatility of the machines.

We're also looking at stand-off minefield detection technologies that were demonstrated in California late last year. As we get into the middle 90's, we'll make a down-select in terms of that capability. So the maneuver commander, perhaps with an unattended vehicle, can detect—from a large stand-off distance—where those minefields are in front of him. Whether they've been surface laid or buried, the technology can give you the outline of what they look like to help the commander make decisions.



"We've got the finest professional noncommissioned officer corps that we've ever had in our history. And I think probably in the world, when you get down to it."

We're also looking at bi-modal explosives, to help with some of the dynamics of assaulting things. Dispersed—some call them fuel-air explosives—is one type. The other type is a line-charge within a line-charge, that gives you two pulses. The value of those is they defeat the sophisticated fuzing that you find in some of the modern mines, which are blast-resistant.

Another equipment change will be the heavy assault bridge, the Class 70 assault bridge. Depending on your METT-T, the carrier will be able to fire either the MICLIC or VOLCANO, or haul the bridge. The bridge will have two lengths—a 24-meter span, or two 12-meter spans. Depending on what intelligence tells you is ahead, you preconfigure the machine, and you're ready to go. It will have the same kind of a chassis as the main battle tank that the majority of maneuver forces would have, so that you're able to keep up.

Those are some of the changes we'll be seeing.

ENGINEER: *Turning the subject for just a moment—what are your thoughts on the role of the NCO in today's Army? I've talked to a couple of NCOs who claim to know you pretty well, and they say you have some strong views on the subject.*

MG Schroeder: That's an understatement. We've got the finest professional noncommissioned officer corps that we've ever had in our history. And I think probably in the world, when you get down to it. They are smart, they are the maintainers of the standards. When you talk about the individual competence, or the competency levels of the individual soldier, that's the squad leader's responsibility. The senior noncommissioned officer in a company is not only responsible for the training of his NCO's, he's also responsible for the individual soldier training status within that company, in terms of meeting standards and knowing their skills.

For a command sergeant major—just ratchet that up a notch. His responsibilities are to make sure those individual soldiers know their basic blocking and tackling. That means he's got to be more competent than others, in terms of what his business is. We're combat support guys—we support the maneuver arms. That means the challenge for that NCO is to lead by example and know the other guy's language as well.

I mentioned standards. You talk about a professional corps of anything, and there's a right of passage, a body of knowledge, and then there's a self-policing mechanism that usually sets professionals apart. I think for the first time in our Army's history you've got that in a professional NCO corps. The noncommissioned officer education system that we have in place now has the right bodies of knowledge, skills, and attitudes—both functionally and in the common leader business. The right of passage is the successful completion of those steps. And we shouldn't blink—we need to make sure that they do that. And I think NCOs make sure they do that themselves. For example, the new senior enlisted evaluation report. The guys who are the strongest advocates of an NCO rating profile system in there to keep everybody from being perfect, are the senior noncommissioned officers. And that's a good reflection on them and their standards. In the successful accomplishment of the professional education business, the toughest guardians of the standards there, to make sure they're met, are the NCOs. But the future, with the self- development test as opposed to an SQT, means an investment of themselves in their own profession. So you're going to get a truer measure of the man, if you will, in terms of "What's he willing to invest in his own self-development?" It's going to make it very competitive, and I think, it's going to enhance their stature within the organization of things.

That's the quality that I see in the NCO corps. Their responsibilities are more functional than titular, and they are more willing to be held accountable. Squad leaders today are superb in terms of understanding their training accountability for soldiers. It hasn't always been that way...

ENGINEER: *Let me get personal for a minute. How much of your success as a leader, as a person, as an officer, do you owe to NCOs that have been a part of your past and your Army career?*

MG Schroeder: You'd have to say, as a part of my life. Probably the majority, in terms of the voices you hear. You hear the voices of guys like Pappy Shearon and C. P. Counts, and you can get melodramatic in that context. But when you think about unselfish service, looking out for your soldiers, sharing their hardships, and providing them with good, tough, realistic training, those are the voices that call for that. They're the guys that say caring for your soldiers doesn't mean being permissive. Caring for your soldiers means making sure that, as their leader, you make them do the tough things that have to be done to protect them and guarantee their survival. One guy puts it, "They've got enough friends. They don't need you as a friend. What they need for you to be is their leader." That came from a sergeant.

ENGINEER: *In your own past?*

MG Schroeder: That's right. From my experience. Good advice. And those are the voices you hear most of the time.

ENGINEER: *Do you still listen to them?*

MG Schroeder: Oh, yeah. I try to. If I ever stop, it's time to do something else.

ENGINEER: *How do you see engineer forces coping with some of the projected budget cuts we're hearing about?*

MG Schroeder: The traditional answers aren't going to work. Locally, I think the biggest challenge to us in the training environment is to figure out how we can exploit every dollar that we have, in order to apply it to good, meaningful training. The temptation is to hunker down and say "I can't do this, I can't do that, because I don't have the money." Wrong answer. WRONG ANSWER. We need to keep squeezing it, and being creative in terms of how you do that. Example. In a mechanized outfit, you do annual rifle qualification every year. There's another training opportunity along with that: movement to the range. Left to their own devices, what most units will do is move administratively. Load up the trucks at 0800, go out, run four firing orders, shoot their rifles, back in the trucks, and come back. WRONG ANSWER. If you have to go do that function, why not make it a movement to contact? Start in the motor pool, maybe a little earlier in the day, and go through the loading training, the outloading, uploading, and all that sort of stuff, and the movement techniques enroute. It takes a little planning and coordination. You get there—break, break—fire your rifles for qualification—break, break—back into a tactical setting and do something else. Those kinds of things.

As the branch proponent, making sure that the right things get priority for resourcing. If you looked at our battlefield deficiencies, if you will, and the analyses that you go through—what's our most glaring deficiency today? It's probably in the countermine area. So what that says is that, the standoff detection, the ability to breach, and then the ability to clear mines ought to be on the front burner. The remote minefield detection system that we're chasing right now, the combat mobility vehicle, and different techniques to do clearing of minefields, are where we're recommending that people invest their efforts. Good payoff on all three of those areas potentially.

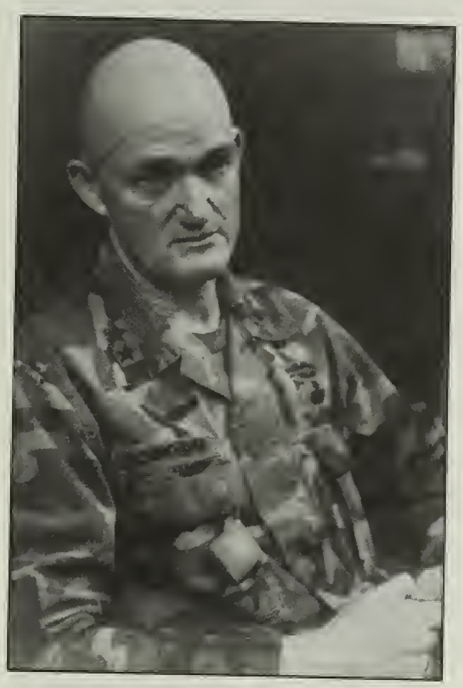
We also need digitized terrain analysis. On the nonlinear battlefield, the ability to visualize the terrain becomes more important. Paper maps ought to be a thing of the past. Commanders ought to have a terminal, punch a button, and a digitized map appears. You want a copy of it? Hit a button and it's printed. That's a good place to put your investment in our business.

You also look at the versatility of the machines, so as we contemplate these various machines, we want greater versatility. Sooner or later, from the nation assistance point of view, and a base operations point of view, we're going to have to do something about the commercial construction equipment that we have. There's still a notion that says "I can't afford to buy as much as I need to satisfy every job." So I want these machines to have different capabilities so they can get to jobs quicker. What that says is a high-speed tractor. Maybe it doesn't have the same drawbar pull, or strength that a D-9 bulldozer does, but the fact that I can put it to work on two jobs in the same time it takes the bigger one to get to one job, to me says something. If you have a variety of attachments, that means all I have to do is buy the power unit, and attachments—and that makes sense. If it also happens to be self-deployable, which means probably not a steel track, and it means no dunnage when you pull it up on a C-130, and when it rolls off the 130 it's ready to go to work. I think, in the future context, that has greater value than some of things we see today.

***ENGINEER:** What's the role of the Reserve Components in all this?*

MG Schroeder: They comprise two-thirds of the force. I don't see that diminishing. If anything, proportionally, they'll increase. When you look at the capabilities, especially the reinforcement for contingency operations or to reinforce forward deployed forces, they take on an added importance in terms of them being competent, capable and ready to go.

What's our role in that? We provide the doctrine, we deliver the training, we provide the structure, and we provide the equipment. It's a one-Army approach in those contexts, and that works. You see demonstrations of that, I think, in Central America all the time. You look at the last deployment for training into Honduras, and it had a mix—command and control by an Ohio National Guard headquarters. It had an active battalion's company in there, and it had rotating units out of the West Virginia Guard and the Ohio Guard. And it worked—the centerline didn't deviate, it stayed straight. That's a "good news" message.



"Caring for your soldiers means making sure that, as their leader, you make them do the tough things that have to be done to protect them and guarantee their survival."

***ENGINEER:** What does the Engineer School do to instill the "warrior spirit" in engineer soldiers?*

MG Schroeder: That's a cultural-energy level question. You can talk about it—instilling the warrior spirit in people—but you can't infuse it in folks unless they can draw it from those that are around them. Field Marshall Earl Wavell says no amount of education, no amount of training or any common sense or anything else, can make up for the crucial element which is the warrior spirit. And what he's talking about, basically, is the approach to problems and to things. It's really a bias for action. And in our business, you call it the warrior spirit, because warfighting is our business. But what it means, basically, is having a bias for action. Not being passive about conditions, being in charge. Being in charge of your own destiny, whether you're in charge of your organization or yourself. It's a spirit that says find the positives. You can stand back and wring your hands over the negatives all you want, but it doesn't do any good. It's an energy level that says "you can't wear me down."

How do you instill that and infuse that in people? It's got to come from those who are around them, and it's got to be allowed to take place. That means you have got to encourage decision making at the appropriate levels, get rid of micro-management. Give someone who's in a leadership position the authority to make the decisions that are appropriate for everybody, no second guessing. Don't put them in the position of having to second guess you. The bias for action piece means, basically, in the absence of any instruction, to "do the right thing." Don't wait for someone to arrive to give you instructions. That's bad. I wouldn't care whether you were in the Army business, or making sports coats, you don't want to just wait for someone to come and tell you which way to go, you want your subordinates and your organizations to have an enthusiasm about them—it tends to affect others as they arrive.

The particular application in our business starts out there in basic combat training. In weather like we've had this winter, where some of less fortification would say "Let's go into the gymnasium and do our training." But those who have the warrior spirit say "These conditions aren't going to grind me down. Put your rucksack on, we're going on a 12-mile march." And when you go down range road and see those kids out there in 28-degree temperatures with their rucks on, cold, damp, uncomfortable, but unbent—that's where it starts.

When you get to the noncommissioned officer and the officer training piece of it, it means keeping the small group instruction. It means making sure you have the right instructors doing the teaching, so that what they're getting doesn't get jaded—that they're getting enthusiastic training on things, not just a dull "fill the requirement" regimen.

It also means having an understanding for the history of our business, so that you can demonstrate for them what the outcomes have been in the past. If a soldier screws something up, he thinks it's the end of the world. There are plenty of examples out there of fellows who have "screwed things up" but who have persevered and gone on because they have the warrior spirit. They were indomitable, and couldn't be beaten. For example, Admiral Nimitz, who had some degree of success in World War II. In the years in between the wars, he did a very serious thing from a Naval officer's perspective. He grounded a ship. And yet, look what he did afterwards, and the contribution he made to the nation in WWII. We could go through George Patton's history, back in his younger days, or Dwight Eisenhower's, or any number of soldiers who have the warrior spirit, and find similar examples. You just couldn't keep them down. That's where it comes from. It's an energy level, an enthusiasm, and a bias for action.

ENGINEER: *Have you ever "grounded your ship?"*

MG Schroeder: Want to go back to the beginning? I've grounded a ship a couple of times, both as an enlisted man, and as an officer, and have persevered. You can't be afraid to make decisions. Everyone makes mistakes. But that's the only way to learn some things in life—and the Army. You must give your subordinates the opportunity to make decisions on their own—and the opportunity to survive their mistakes. You've got to have confidence in your training, your people, and yourself.

ENGINEER: *What's an Engineer?*

MG Schroeder: He's a lot of people. He's very diverse. You look at the different things that the engineer soldiers do for the Army and the nation, and you get a feel for the remarkable range of missions that the engineer carries. It ranges from sapper and combat heavy battalions, to district engineers. That's a range you don't find anywhere else.

Within the context of the combined arms team, engineer soldiers work hard, they persevere, they have the knack for innovation and finding creative solutions for things that may appear insurmountable. And that's from private to general—the innovativeness, the creativity, no problem too difficult, "we'll find a way to fix that." You find that, I think, throughout the organization. In the direct, close combat context, you see sergeants who know how to get across gaps, and through obstacles, and over terrain, and impede the enemy's progress in ways that people haven't really considered.

In managing the nation's waterways and military construction programs, you see value engineering ideas emanating from soldiers that basically set a trend for industry.

But I think the common denominator across the board, that pervades all engineer activities, is ethical leadership. Whether it be a sergeant leading a platoon in support of a battalion task force, or the colonel trying to decide how much water to release from a dam in the upper reaches of the Missouri River. The integrity and the ethical leadership is the foundation of both of them. And I don't think that is matched anywhere else.

ENGINEER: *You talked about not being afraid to make tough decisions. You're an Army general who graduated from the Naval Academy. Which side of the field do you sit on during the Army-Navy Game?*

MG Schroeder: My allegiance to my alma-mater hasn't waned over the past 29 years. If it had not been for the opportunity to go to that institution, and graduate from it, I'd probably be a state policeman in upstate New York. I know there are those who have said that the Army would be better off if I were (chuckles).

Does that tell you which side I sit on? At that time of the year, you'll notice that neither my wife nor I will wear a button that says "Beat Army." But we do wear the button that says "Go Navy!"

***ENGINEER:** How has the Engineer Branch changed since you came in?*

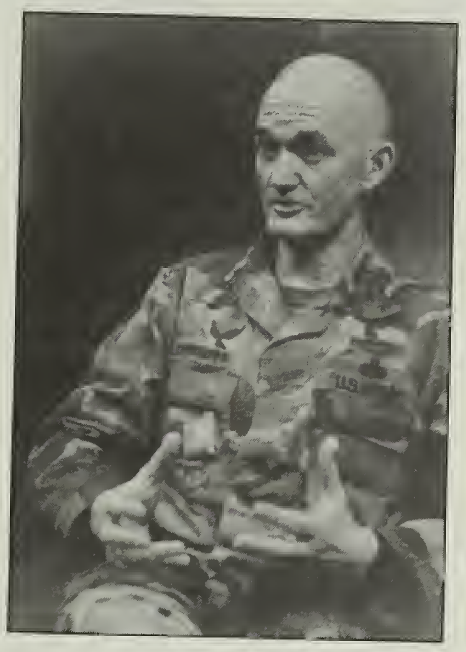
MG Schroeder: Nature of the work? No. Quality of the work and those performing it? Yes. Preparation for the work to be done has improved considerably. The integration of engineer soldiers into the combined arms team, on the battlefield, and in training, is much better today than it was "in my day," as the expression goes. And continues to get better. The degree of responsibility has increased. The scope of the authorities that engineer officers have throughout their assignments has increased. So if you get away from the equipments and that sort of stuff, the organizational structures, the natural evolutionary things, I'd say those characteristics have changed. The other part of your question should be, "Has that been for the better or the worse?"

***ENGINEER:** OK, I can take a hint. Has it been for the better or the worse?*

MG Schroeder: In my view it's been for the better. In large part because of the challenges that are inherent in those changes. And what that then allows you to attract, in terms of quality of soldiers, and the standards that the soldier is willing to meet, and the same thing in respect to the officers. I think that the intrinsic value of the work itself is what continues to attract the quality soldier.

***ENGINEER:** If there is one important lesson you could impart to young soldiers today about your combat experience, what would it be?*

MG Schroeder: Trust. Good units trust each other. I think if you ask soldiers then and now, what is it you want out of your leaders, I think the answer they would come back with would be, their trust. Whether we will trust them to do the right things. I want to be able to trust them to share my hardships. I want to trust them to know what to do. And what that speaks to is being technically competent, knowing what the standards are and insisting on them being met. It means being consistent. And sometimes it means being hard, doing the tough, right things. There's a tough caring in there, it's not a permissiveness sort of a thing. I don't think soldiers want permissiveness. What they want is to be cared for properly. They want to be able to trust you to do everything possible to protect them, and to keep them from harm's way. That doesn't mean bottle them up and put them off in a safe environment. That means train them hard to where they know the right things to do. And it means do the hard right things. Trust in training means train me hard, to the right standards. Don't be weak-kneed about it, and don't take me to the gymnasium for physical training during the winter. It means make me overcome the adversities that are out there, but do it in a caring kind of way. I mean, when you do that, you do it because you care about them and you want them to survive the hardships—and survive battle.



"Our soldiers deserve the best training that we can give them. Once they're on the battlefield, it's too late to go back and give that young man or woman the tools they need to get their mission done—and to come back alive."

***ENGINEER:** Does the Engineer School do that?*

MG Schroeder: I think we do. And we do pretty well at it. We're not quite at the point where I'd like us to be yet, but in terms of the leader development business and the NCO Academy, and the officer courses here, that's one of the premises we try to build on. And you get at that in a number of ways. Performance-oriented training. Train to standards, don't just train to time. And keep training to standards until the standard is met. It argues for small group instruction, with the right kind of leader in the group. It argues for hands-on, performance-oriented training in a field environment, not in a classroom or a laboratory. And it means not backing away from the arduous tasks that have to be performed. And it means developing the skills that you have to demonstrate your competency in order to earn the confidence of your soldiers. And it's a confidence that you earn, you can't just walk up and insist on it.

Our soldiers deserve the best training that we can give them. Once they're on the battlefield, it's too late to go back and give that young man or woman the tools they need to get their mission done—and to come back alive.

We need to do that here, and now. And I think we're doing the right thing at the Engineer School.

Readiness:
It's Everybody's Business

By Colonel Ron Dabbieri

Unit readiness is defined as "the ability of a unit to perform as designed." Every commander and soldier needs to know how that ability is measured, how the resulting information is used, and the individual's role in unit readiness.

The USR

While no single instrument completely measures unit readiness, the unit status report (USR) is designed to measure the critical status of resources and training at a given point in time. The USR is widely regarded throughout the Army as the readiness yardstick, and until 1978 was even called the unit readiness report, or URR. Therefor the sake of this article, I'm going to address readiness in USR terms.

As a general rule, USRs are submitted monthly (with data as of the 15th of each month) by MTOE (modification table of organization and equipment) units that would likely be deployed in contingency operations like Desert Shield/-Desert Storm. These units include battalions, separate companies, separate detachments, and equivalent-sized units. USRs also cover a few TDA units.

Army Regulation 220-1, *Unit Status Reporting*, governs reporting procedures, and quotes in this article are taken directly from the regulation. The report itself is submitted on a DA Form 2715.

> **"Mission failure and needless loss of life could be the end result of dishonest reporting."**

The major resource areas rated in the report are:

- Personnel
- Equipment-on-Hand
- Equipment Readiness/Mission Capable
- Training

A unit's overall rating is usually "the lowest unit status level attained in a measured performance area." However, a reporting unit commander, based on his professional judgement, can subjectively "upgrade or down-grade the unit's overall level if the calculated level is not truly representative of the status of the unit."

Each measured resource area, and the overall unit, is assigned a numerical "C" level. "A level of C-1 is the highest, levels of C-2, C-3, and C-4 are used to indicate a lesser unit status and ability to perform as designed." Units may be organized by the Army at these lesser degrees of ability.

Units are not expected to achieve C-levels above the level at which they are resourced. For instance, a unit may be organized at an authorized level of organization (ALO) 2, and have authorization for only 85 percent of the "wartime required" personnel level. This particular unit was organized at a decreased status by design, and therefore would be expected to report a C-2 status/readiness level.

Using the USR

With an explanation of the system out of the way, let's discuss how the reports are used, and why everybody has a stake in maximizing readiness.

The USR reports your unit's status up through the chain of command. It is used to allocate resources and, often, to select a specific unit that has the capability to fulfill a contingency mission. Commanders and their soldiers have an obligation to maintain the highest unit status possible, within the constraints of their resources and assigned ALO.

Commanders also have an obligation to report their unit's status accurately. Inaccurate reporting that portrays the unit as being more capable than it is could spell disaster. Based on a high USR, such a unit could be selected for a mission that is beyond the organization's true capability. Mission failure and needless loss of life could be the end result of dishonest reporting.

On the other hand, it is equally important not to downgrade a unit's true capabilities. A commander who dishonestly reports his unit less capable or ready than it actually is—even if it is in his misplaced zeal to err on the safe side—may have eliminated his unit from consideration for a particular mission. Then some other, less capable, unit may have to go and do that unit's fair share of the fighting and dying.

Inaccurate reporting could also result in a unit getting an unfair share—or failing to get its share—of critical resources needed to improve deficient resource areas. Reporting commanders need to understand all the reporting criteria, make every effort to achieve the highest USR level possible, and then be scrupulously accurate about reporting that level. It should be morally reprehensible to commanders of integrity to obtain undeserved resources—or avoid combat—by inaccurately downgrading their unit's capability. It would be just as reprehensible to try and avoid personal criticism by dishonestly upgrading it.

Everybody's Business

Now that we have discussed status/readiness reporting and how it's used, let's look at why readiness is everybody's business and what we can all do to maximize it.

Units are designed to perform certain missions. A unit that is organized at ALO 1 should have 100 percent of its TOE (table of organization and equipment) design capability when:

- It has all of its required personnel and equipment.
- All its equipment is in good working condition.
- The unit is fully trained.

This unit has a status level of C-1. It possesses "the required resources and is trained to undertake the full wartime mission for which it is organized or designed." It should be obvious to everyone that a C-1 unit called into combat would have a much better chance of accomplishing its mission and surviving than a C-2, C-3, or C-4 unit.

The chain of command shouldn't be the only influence on readiness. Unit mechanics, supply clerks, fire team members, and everyone else in the unit has the ability to affect readiness. But all too often, soldiers aren't informed how they fit into the readiness equation. I now want to explain how everyone can substantially improve readiness by going "above and beyond," instead of simply doing their job. Using what I call the MELE (minimum essential level of effort), the USR resource areas, and reporting criteria, let's look at what we can do to improve readiness.

Personnel

The USR "provides indicators of a unit's personnel status by developing a C-level that is calculated by comparing available strength, available MOS-trained strength, and available senior grade strength to wartime requirements." Commanders and others involved in personnel assignments must ensure that soldiers are properly slotted. Unit S-1s and personnel NCOs must check to see if any of the unit's overstrength MOS personnel have a secondary (SMOS), additional MOS, or substitutable MOS that matches a vacancy required by the unit. If you have such personnel, count them, for readiness purposes, as MOS-trained against appropriate vacancies.

Adjutants also need to know that MOS "trained" and "available" is a 3-digit MOS match. This means you can't downgrade the personnel resources of your USR because your soldiers don't have a specific ASI (additional skill identifier), SQI (special qualification identifier), or LIC (language indicator code). The only exception is for certain military intelligence MOSs that require a specific language.

Additionally, "senior grade" is sergeant (E-5) and above.

If you have people who are not trained in a specific SQI, or not certified to grade, i.e., divers and watercraft operators, address this in the "training" area of the USR. Alternatively, it can be given as a reason to degrade the overall status rating of a unit. It is not a personnel issue.

Commanders, if you have a senior grade shortage, have you boarded all your qualified corporals and specialists? By doing this, you can grow some of your own NCOs. Or are you waiting for someone else to grow them and send them to you? What makes you think that another unit's specialists are better or more deserving of promotion than yours? If you've pursued these avenues, you've done your MELE duty as far as personnel are concerned.

Now, have you taken the extra effort to go to your battalion, brigade or post AG/strength managers to verify that they are aware of your requirements? Have they checked to see if the people you need are improperly slotted or in reassignable overstrength somewhere else on post? Also, ensure that your non-available people who have lost their MOS qualification have been properly reclassified or eliminated.

In a vast majority of cases, the soldiers that you need to fix a personnel readiness problem are right on the installation.

Unfortunately, no one has made the extra effort to identify them and move them to slots where they can count toward unit readiness. If they aren't already on post, your AG can usually plug into the right place at PERSCOM (U.S. Total Army Personnel Command) to fix the problem. Remember, it's the squeaky wheel that gets the grease. Don't just accept your unready condition. Do everything in your power to fix it.

Equipment On Hand

The USR "provides indicators of a unit's equipment on hand (EOH) status by developing a C-level that is calculated by comparing the fill of selected equipment to the wartime requirements." Normally, the equipment counted in this area is indicated by an equipment readiness code (ERC) "A," or ERC-A, on the unit's MTOE. These are the primary weapons and equipment a unit needs to go to war. Just like personnel, equipment must be properly slotted. It is possible to have identical items required on both an ERC-A and ERC-B line of your MTOE. Fill up your ERC-A lines first, since these count toward readiness.

Also, an ERC-A item can be a component of an ERC-B item. A good example of this is a PRC-77 radio. The PRC-77 may be an ERC-A line. A GRC-160, which has a PRC-77 as a component, may be an ERC-B line. Use your PRC-77s to fill your ERC-A lines before you use them as components.

Commander, S-4, supply sergeant, and supply clerk: have all missing items been properly ordered? Do you have a good status on them? When was the last time you checked on them? Did you post the status as soon as your status cards came in? If something happened to the requisition, did you research it immediately, and get it back on order the same day? If the item came in, did you pick it up immediately? Remember, every day counts for readiness. When you have answered "yes" to these questions, you have fulfilled your MELE.

But don't stop there. Have you gone to see the property book officer at division/post? Is the item sitting in a warehouse somewhere on the installation? Does another unit have one that they are not authorized? Or do they have one that is not an ERC-A item for them? What are you doing to energize the system?

All too often, leaders and key personnel are satisfied to expend their MELE and then sit back and complain about the unresponsiveness of the system. These individuals keep hoping for the perfect world where everything happens just right, and the items come in right on time. Wake up! Don't forget the wheel and the grease. Are you "squeaking" yet?

Equipment Readiness (ER) & Equipment Mission Capable (EMC)

The USR "provides indicators of a unit's equipment readiness by developing a C-level that is calculated by comparing the combined effects of fill and maintenance shortfalls on the status of selected equipment to wartime requirements."

In simpler terms, ER is the percent of time a unit's ERC-A maintenance reportable items on hand (vehicles, weapons systems, radios, etc.) are fully mission capable. EMC is the percent of time those items are working when compared against all required items. For EMC, those items not on hand are counted as not working. The overall C-level in this area is the EMC, which will always be equal to or lower than ER.

Equipment readiness is truly everybody's business because every piece of equipment is assigned to someone. For the sake of discussion here, let's use the squad vehicle as an example. It could be an APC, a 5-ton dump truck, or any other appropriate vehicle. When a squad vehicle is down, the effect on readiness is obvious. The squad can no longer perform its mission, and can't even haul their weapons and equipment.

The first thing that's needed here is to find out what is causing the deadline. Almost every vehicle has a "dash-ten" manual that lists the PMCS (preventive maintenance checks and services). If the PMCS uncovers a deficiency, does it deadline it? Often, a deficiency that keeps a vehicle from leaving a peacetime motorpool does not keep it from going to war. A good example is headlights. You may not want a vehicle with no headlights on the road around your home post for safety reasons, but lack of headlights is rarely a PMCS deadline item. If you're a motor sergeant, platoon leader or commander, and you're calling the vehicle down for this deficiency on your DA 2406—you're lying on your USR. Okay, now everybody has been educated and knows how to use a dash-ten.

Keeping the squad vehicle in tiptop condition is every squad member's responsibility. First, find out exactly what is wrong with it, what echelon of maintenance is responsible for fixing it, and get it operational as quickly as possible. If it has to go to support maintenance, get it prepped and accepted immediately. Each day the vehicle sits in your motor pool is a day wasted. You should work around the clock, if need be, to get the vehicle accepted by support maintenance.

If the required maintenance is at the organizational level, make sure of the fault diagnosis and make sure all required parts are properly ordered. Platoon leaders, platoon sergeants, squad leaders and drivers should be the people most interested in getting the vehicle operational.

Have you checked to see if the parts on order are the right ones? Do you know how to read a "20P" manual to check part numbers? Have you checked the document register to verify for yourself that the parts are on order? Have you checked the PLL (prescribed load list) to see if the part is already there? Do you know how to read status cards? Have you gotten a good status back? Did the requisition even pass? If the requisition was cancelled, did you find out why and get it back on order the same day? When the part came in, did you make sure it was picked up and installed on the vehicle immediately—not tomorrow or the next day?

Remember, every day a vehicle is down counts against your readiness status. What happens if your part comes in on Friday afternoon, you decide to wait till Monday to put it in, and you get called out on a contingency mission over the weekend? Your window of opportunity to get the vehicle up has passed. Don't wait. Get the vehicle mission capable as soon as you can. If you've done these things, you reached the MELE point for ER. But keep going.

Have you gone to support maintenance to check on your vehicle's status? Is someone working on it, and are the right parts on order? Do you know what a "30P" is? Have you been over to your sister companies and battalions to see if you can find the part on someone else's PLL?

Again, it is all too easy to complain that the "system" isn't working like it should. If everybody was doing their job properly, the part would come in promptly and the vehicle would be fixed. Unfortunately, in the real world, this attitude is a lazy man's dodge. Get the job done, even if you have to expend the effort to prime the system and push it through.

Another hint to help maximize ER goes back to my PRC-77 example. If your PRC-77 went down, did you immediately swap it out on your hand receipt for the nonreportable one in the GRC-160 so the operational one appears on your ERC-A? Also, when you have identical items listed as both ERC-A and ERC-B items, do you do a similar switch to maintain readiness? For example, assume your mess 2 1/2-ton truck is an ERC-B, and your ammo 2 1/2-ton is an ERC-A. If your ammo truck went down, did you immediately replace it on the ERC-A with the mess truck to avoid down time against your ER?

The EMC part of this resource area was addressed earlier, in the EOH section of this article.

Once more, have you done everything possible to get your downed vehicles running? Are you still squeaking?

Training

The USR "provides indicators of a unit's training status by developing a training C-level...to show the current ability of the unit to perform its assigned wartime mission..." The standard by which this is done is the mission essential task list (METL). While this is an area that can be highly subjective, it is also an area where soldiers can make the greatest individual contribution.

In order to be proficient as a unit, each soldier must first be proficient in his individual tasks. For example, to conduct a dismounted attack, each soldier must be skilled with his individual weapon, be physically fit, know his basic infantry skills, and know his unit drills. Leaders must also know their individual skills and be tactically proficient in leader-associated METL tasks.

Because soldiers only do in combat what they have learned and practiced in training, everyone must ensure that tough, realistic training is conducted to standard. Leaders at all levels must be educated to recognize good training, and know how to perform tasks to standard. Two old sayings are appropriate: "sweat shed in training saves blood shed in combat," and "it ain't hard to meet your standards if you ain't got any."

It is in the evaluation of training that all leaders need the highest degree of integrity. First, they must know all the tasks that are to be evaluated. Next, they must demand that soldiers perform those tasks up to established standards. It is a misplaced compassion to be soft on soldiers and allow them to do less-than-acceptable training. In combat, it is the properly trained soldier who will survive. True compassion is making soldiers do the tough, realistic things in training that will give him greatest chance of survival.

What It All Means

Now that you have your 2715 made out, who looks at it? This form gets looked at

(Continued on page 58)

Engineer Problem

DELIBERATE BREACH

This is the second of four Engineer Problem/Solution articles dealing with breaching operations; the remaining two will appear in future issues of ENGINEER Professional Bulletin. *The articles reflect concepts outlined in FM 90-13-1,* Combined Arms Breaching Operations, *which was distributed in February 1991. This problem focuses on the deliberate breach.*

The scenario in this problem illustrates teaching points on the deliberate breach. The enemy scenario and obstacle depicted represent what you may expect to encounter in a desert environment, either in southwest Asia or when fighting the Samarans at the National Training Center. An excerpt from FM 90-13-1 describes the characteristics of a deliberate breach and when it will be used.

The problem-solving process is presented using the engineer estimate process and includes some key discussion points. For more information about the engineer estimate process, refer to Lessons Learned, page 52 of this issue.

Problem: As the task force (TF) Engineer and engineer company commander, you are to recommend a task organization of mobility assets to the TF Armor commander for the task force's deliberate attack. TF Armor is conducting the supporting attack for the brigade. Their mission is to penetrate the enemy's forward defense and secure the left flank of the brigade's main effort.

Situation: You are the commander of Company C, 52nd Engineer Battalion (C/52d EN Bn), a divisional mechanized sapper company. Your unit is attached to TF Armor for their deliberate attack. TF Armor is task organized with three tank companies, two mechanized infantry companies, and your engineer company. The brigade (-) will attack along Axis Punch, penetrate the enemy forward defense, and continue the attack along Axis Hook to destroy the Regimental Artillery Group (RAG) on objective (Obj) Gun. TF Armor's mission is to attack along Axis Jab, breach the enemy's complex obstacle, secure Obj Pit, and occupy battle position (BP) 10, as shown in Figure 1, page 33.

The TF commander focuses his planning on four phases:

Phase 1— Rapid movement from the line of departure/line of contact (LD/LC) to the complex obstacle

Phase 2— Breach of the complex obstacle

Phase 3— Assault and secure the enemy trench line

Phase 4— Rapid movement of forces through the breach to establish a hasty defense near BP 10.

As a result of the intelligence preparation of the battlefield (IPB) process, you and the intelligence officer (S2) have developed the enemy situation template shown in Figure 2, page 34.

The TF commander has selected the maneuver plan shown in Figure 3, page 35. A scout platoon leads the TF formation. The support force is task organized with two tank heavy teams (each team: 2 tank and 1 mech platoon); the assault force is organized with one mechanized infantry heavy team (2 mech and 1 tank platoon) and one mechanized infantry company (-) (2 mech platoons). The TF commander plans on a tank company(-) (2 tank platoons) as the TF reserve.

The maneuver plan is designed around rapid movement along Axis Jab, with the task force in a modified VEE formation. Artillery preparation of Obj Pit begins when the task force crosses PL Hammer. The lead element, which is the support force, maneuvers into attack by fire (ABF) positions 1 and 2. They begin direct fire suppression of the enemy trench line and adjust indirect fire and smoke.

Engineer Problem

The TF commander will first determine that direct and indirect fire suppression and artillery smoke obscuration on the trench line are effective. Then he will order the breach force forward to begin breaching lanes through the complex obstacle. When the breach is complete and the breach force gains a foothold on the far side of the obstacle, the assault force will assault and secure the trench line. The support force will pass through the breach lanes and move on Axis Lead to occupy BP 10. The assault force will consolidate, reorganize, and occupy BP 25 (Figure 3, page 35).

Based on information gained through the IPB process, the TF commander does not expect to encounter any tactical obstacles or strong enemy resistance in the enemy security zone along Axis Jab. Reconnaissance will confirm this. He has chosen to conduct a deliberate breach of the complex obstacle.

The TF commander has identified you as the breach force commander. He has given you guidance to mass most of the engineers and breaching assets in the breach force, and to provide sufficient engineer support to the assault force. He wants you to provide at least two lanes through the complex obstacle.

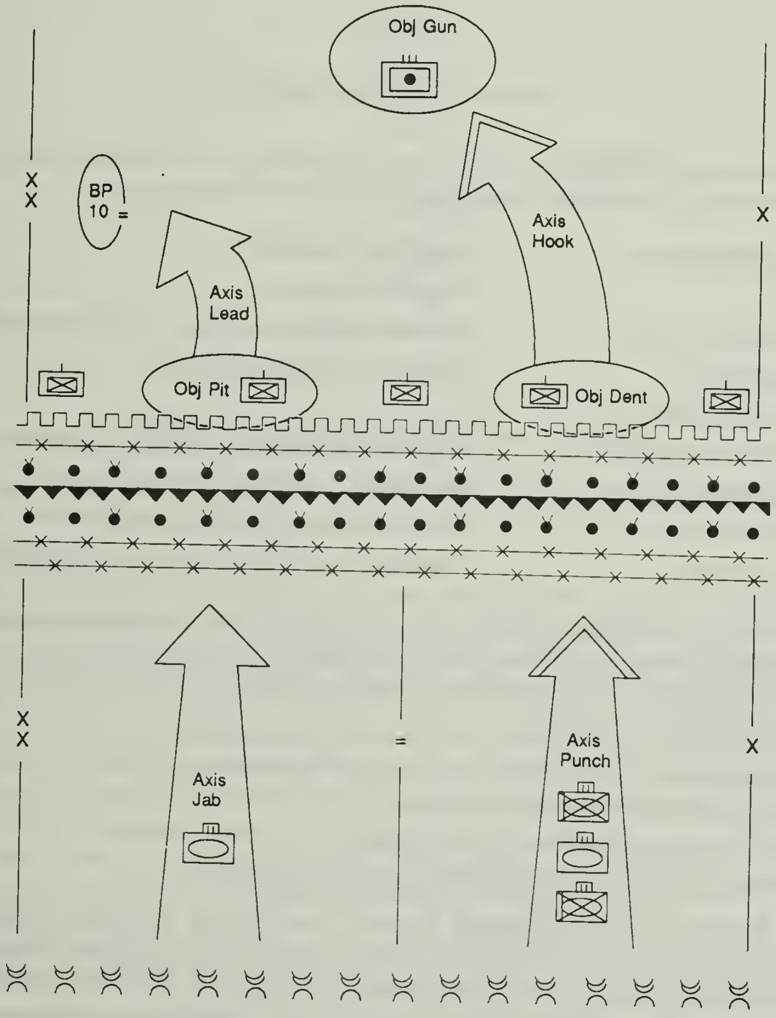


Figure 1. Brigade/Task Force Operations Overlay

Engineer Problem

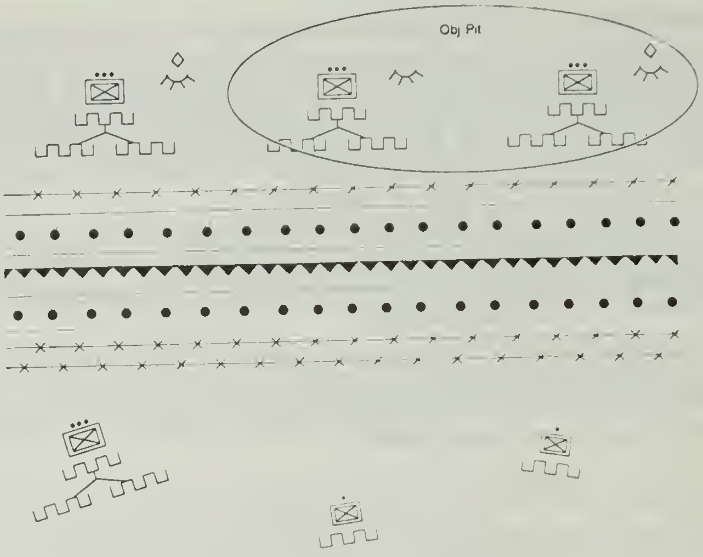


Figure 2. Situation Template

Problem-solving Process. The engineer estimate, an integrated extension of the command estimate, is conducted concurrently with other staff estimates.

Command Estimates	***Engineer Estimate***
Mission	*Engineer mission*
Facts and assumptions	*IPB and engineer battlefield assessment (EBA)*
Mission analysis	*Engineer mission analysis*
Commander's guidance	- - - -
Develop courses of action	*Develop a scheme of engineer operations*
Analyze courses of action	*War-game and refine engineer plan*
Decision	*Recommend a course of action*
Action and orders	*Prepare final engineer plan and issue orders*

You have enough information to start developing a scheme of engineer operations. Use essentially the same steps (in the order presented) the command used for developing courses of action to develop the scheme of engineer operations:

1. Analyze relative combat power
2. Identify engineer battlefield missions and allocate forces
3. Develop scheme of engineer operations
4. Balance force allocation with assets available
5. Integrate decisions into maneuver course of action sketch

Step 1. Analyze Relative Combat Power. The analysis of relative combat power is based on the situation template and an assessment of enemy and friendly engineer capabilities. Use an engineer battlefield assessment (EBA) to determine these capabilities.

Enemy engineer capability: From an IPB, you determine that the enemy brigade security zone, from the LD/LC to the complex obstacle, does not contain any tactical or protective obstacles. The security zone consists of enemy squad- and platoon-sized trenches, which

Engineer Problem

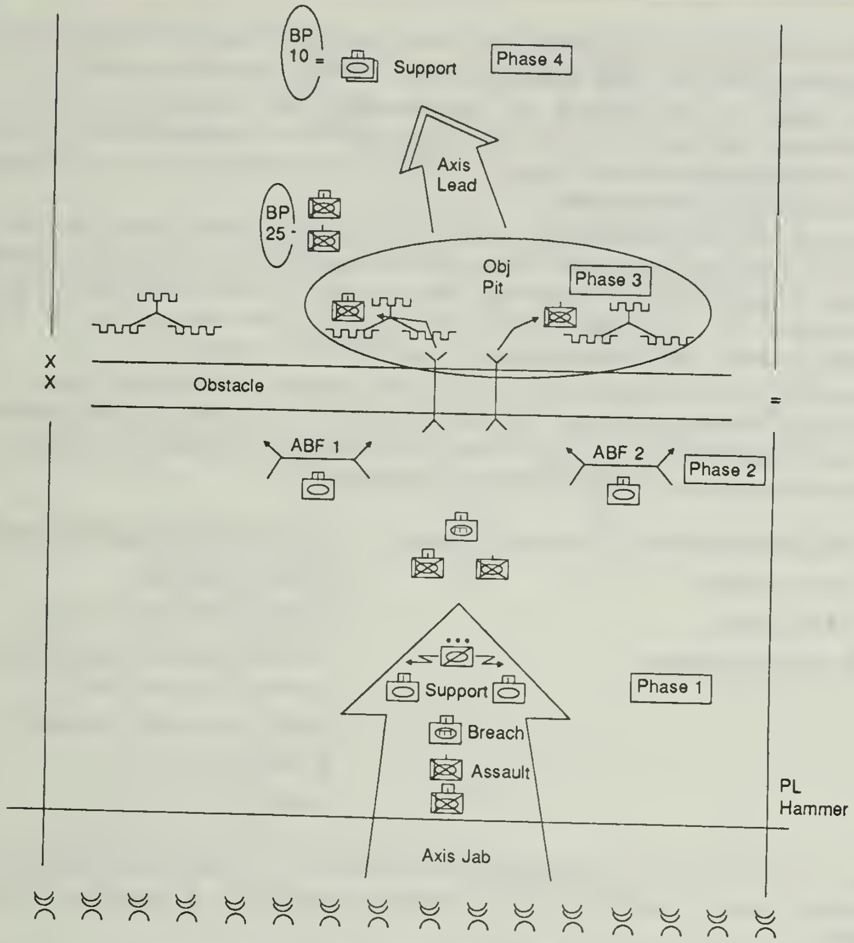


Figure 3. Task Force Operations Overlay

are supported by three or four BRDMs with AT-3/SAGGER antitank guided missiles. The first obstacle the task force will encounter will be the complex obstacle that supports the enemy main defense.

Based on the IPB process, you know that the enemy infantry brigade is defending with platoons and companies on line. The platoons are entrenched with two squads up and one back. Squad positions are connected with a communications trench. Platoon positions contain antitank grenade launcher (RPG-7) and recoilless antitank gun (SPG-9) positions. Two or three tanks, in revetments behind platoon trench lines, support each company. The brigade has a company-sized tank reserve that is located in the brigade sector to the west. It is used to block penetrations. There are no second echelon enemy units in the zone the brigade is attacking, or no known obstacles to the rear of the main defensive line.

You have also determined that the enemy has a multiple rocket launcher (MRL) battery supporting their division. It can range the enemy brigade's main defensive line and employ scatterable mines. Refer again to Figure 2, *Situation Template, page 34*.

The following information is known about the complex obstacle: The first obstacle you will encounter is a triple-standard concertina fence. Behind it is an open area of about 50 meters and a single strand of concertina, which probably serves as a minefield marking fence. A 20-meter open area behind this concertina is followed by a 60-70 meter deep antitank (AT) and antipersonnel (AP) minefield. This is followed by approximately 50 meters of open area and a tank ditch with no berm that is 4 meters wide and 3 meters deep.

Engineer Problem

Behind the tank ditch is a 20-meter open area, another AT and AP minefield that is 60-70 meters deep, a 20-meter open area and, finally, a single strand of concertina.

Total depth of the obstacle is approximately 300 meters. The trench line is approximately 150 meters from the last single strand of concertina wire. The minefields consist of three double rows of buried AT mines, with mines spaced 4 to 5.5 meters apart, and rows spaced 20 meters apart.

Doctrinally, the enemy emplaces three AP mines for each AT mine. You do not know how the AP mines are emplaced. They may be emplaced as clusters around the AT mines or as rows forward of the AT mine rows. Also, you do not know if the enemy has emplaced any protective AP minefields immediately in front of the trench line, or if there are minefields between gaps in the platoon or company trench lines.

Friendly Engineer Capability: For this problem, assessment of friendly capability focuses on the available mobility assets. The following list of TF Armor's mobility assets is based on its task organization (three armor and two mechanized infantry companies) and the mobility assets organic to C/52d Engineer Battalion.

TF Armor Breaching Assets (Organic)	***C/52d En Bn Breaching Assets***
3 Mine rollers	*9 Sapper squads*
9 Mine plows	*2 CEVs (1 with mine rake)*
6 Infantry platoons	*1 AVLM (Note 1) w/2 MICLICs and 1 Fascine (Note 2)*
	2 MICLICs (trailer mounted)
	6 M9-ACEs
	3 AVLBs

Note 1: AVLM - (Armored Vehicle Launched MICLIC) consists of two MICLICs mounted on the back deck of the AVLB launcher (bridge downloaded). It can carry a fascine on the front deck.

Note 2: Fascine - a bundle of 75 pipes (maxi fascine) linked with chains. It is hauled by an AVLM or CEV. When dropped in the tank ditch, a fascine provides a rapid means of crossing a ditch up to 3 meters deep and 4 meters wide. Launch time is less than one-half that for an AVLB.

Step 2. Identify Missions And Allocate Forces: In this step, use the reverse planning process to identify engineer missions, working from the objective back to the LD/LC. Each time an engineer mission is identified, you must allocate the forces needed to accomplish it. Do not constrain the forces you allocate by the assets in your task organization.

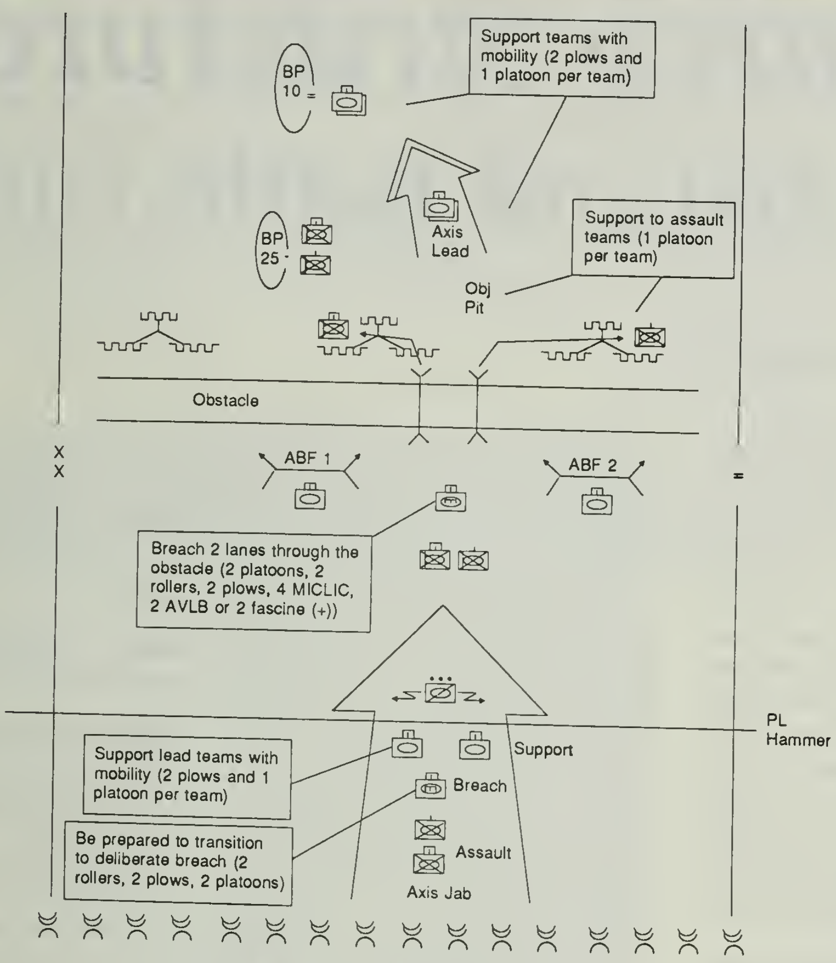
A good technique is to write the engineer tasks and required force allocations on your copy of the course of action sketch or operations overlay. This will identify the engineer tasks and force allocations required for each mission. You will use this information later to develop an engineer task organization and the scheme of engineer operations.

Refer to page 47 for characteristics of a deliberate breach. Note that you should allocate 50 percent more breaching assets than those required for the breach force. A sample engineer worksheet is shown in Figure 4, page 37.

Step 3. Develop A Scheme Of Engineer Operations: The goal of this step is to integrate force allocation, execute engineer tasks, and set engineer priorities into the TF scheme of maneuver and task organization. The scheme of engineer operations is developed by working the maneuver plan from LD/LC through the breach to BP 10.

As you wargame the maneuver plan, note which engineer tasks must be accomplished and the forces required to do them. Task organize these forces to your breach team or to

Engineer Problem



Support teams with mobility (2 plows and 1 platoon per team)

Support to assault teams (1 platoon per team)

Breach 2 lanes through the obstacle (2 platoons, 2 rollers, 2 plows, 4 MICLIC, 2 AVLB or 2 fascine (+))

Support lead teams with mobility (2 plows and 1 platoon per team)

Be prepared to transition to deliberate breach (2 rollers, 2 plows, 2 platoons)

Figure 4. Engineer Working Overlay

the appropriate maneuver sub-unit.

While the deliberate breach ranks as your priority task, do not forget the mobility assets you must provide to the assault and support forces. Remember to allocate mobility assets that are organic to armor companies: As the TF Engineer, you must consider all TF mobility assets, not just those from your engineer company.

Step 4. Balance Force Allocation With Assets Available: As assets become scarce, determine where mobility assets can reasonably be expected to accomplish several tasks. Note all shortfalls. Refine the plan by shifting assets to the main effort, shifting priorities as battle phases change, and requesting additional assets.

Step 5. Integrate Into Maneuver Course Of Action Sketch: Prepare a statement describing the scheme of engineer operations. This statement must address:

- How engineer assets support the maneuver course of action
- Engineer mission priorities for each phase
- Critical engineer events and activities
- Task organization for the missions

Engineer Solution begins on page 45.

Force Structure and AirLand Battle-Future

By Major Joseph M. Seerley

The Army is facing significant changes in both its organization and the way it will fight future battles. The thawing of our relationship with the Soviet Union and the resulting shift away from a European war scenario has underscored the need to modernize our force structure. And the war with Iraq has served to give that process increased emphasis. This article outlines how the Army will conduct future combat and noncombat operations throughout the spectrum of conflict.

First, a few words about the Soviets. Not surprisingly, the Soviet Army is going through a similar period of change. They are currently undergoing considerable force reductions as their doctrine changes from a primarily offensive posture to a more defensive orientation at the strategic level.

The Soviets

Changes in force structure, doctrine, and the size of the Soviet military may change the priority of their engineer missions and the structure of engineer units. However, much like our own Army, engineers will continue to play a critical role in Soviet offensive and defensive operations. The importance of mobility, countermobility, and survivability operations will only increase.

Trends...

Weapons Systems

- Cost ↑↑
- Numbers ↓
- Complexity ↑
- Sensor Capability ↑↑
- Lethality ↑
- Range ↑
- Accuracy ↑

Forces

- Units ↓
- Battlefield Density ↓

Type Conflicts

- Nuclear ↓
- Global-High Intensity ↓
- Regional ↑
- Low Intensity ↑

Resources

- Budgets ↓
- Military Age Personnel ↓

Figure 1

The Soviets have long realized that engineer operations play a vital role in successful combat operations. They have manned and equipped their engineer units to support combat operations on a high-intensity battlefield. The Soviets have the best equipped engineer force in the world, and their engineer assets include a tremendous mine warfare capability. That capability is provided by mechanical and scatterable mine emplacement systems, which permit them to affect our operations throughout the depth and breadth of the battlefield.

Organic to both engineer and combat units are highly capable engineer systems that support mobility, countermobility, and survivability missions. The ability of their engineer forces to keep up with maneuver units, and to survive on the modern battlefield, is excellent.

The importance of engineers, as vital force multipliers, is expected to increase as Soviet forces are reduced to parity or near-parity with Western forces, and are compelled to fight on a non-linear battlefield.

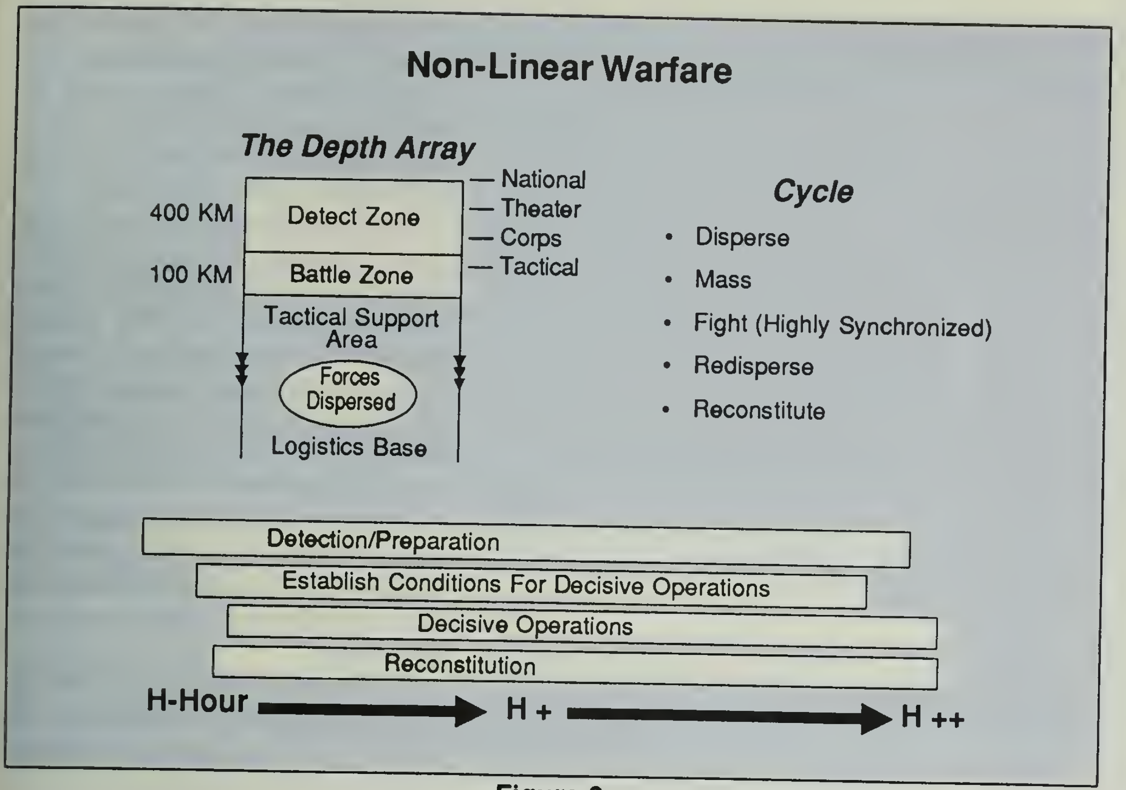


Figure 2

U.S. Trends

Trends within our own Army are shown in Figure 1. The implications of these trends are greater fidelity for intelligence and target acquisition systems, fewer weapons systems due to complexity and cost, and a corresponding increase in lethality based on the accuracy of precision munitions. In addition, battlefield density will decrease due to reductions in force structure.

The conclusions based on these trends are:

- The battlefield will become non-linear.
- Most of the time, we will have the capability to know where the enemy is located.
- We will have the capability to engage the enemy at longer ranges with very accurate and lethal weapons.

In addition, non-linear warfare is considered a condition—not a choice.

Future battlefields will be arrayed as shown in Figure 2. The corps commander will be assigned an area of operations with the mission to destroy, not defeat, the enemy forces. This area of operation, much larger than those in current doctrine, may be up to 300 kilometers (km) wide. It will have a depth of 100 km from the back edge of the detection zone to the front edge of the tactical support area. Based on METT-T (mission, enemy, terrain, troops and time available), the corps commander will determine where in the battle zone he will destroy the enemy force. He will also establish a detection zone, where he will focus his RISTA (reconnaissance, intelligence, surveillance, and target acquisition) assets. These assets will detect, track, and acquire enemy formations moving into his area of operation.

Initially, national and theater-surveillance assets will determine the disposition of enemy forces. As intelligence and warning indicators cause the level of readiness to increase, additional intelligence collection measures will be implemented. These additional assets may include armed aerial reconnaissance, armored cavalry, light cavalry, motorized scouts, and engineers. Maneuver forces will initially be located in the tactical support area, which will allow them to disperse and remain outside the threat's indirect fire range.

During a typical engagement, the maneuver force will occupy dispersed assembly areas outside the threat's indirect fire, then mass at a place and time chosen by the corps commander. The force will fight a highly synchronized battle, re-disperse, and reconstitute if necessary.

The corps will be comprised of several maneuver brigades and division headquarters. The corps commander will task organize the brigades to a division headquarters based on METT-T (Figure 3, page 40). For example, one division could have two brigades and another division could have four brigades. Each brigade will have three maneuver battalions, each with three maneuver companies (Figure 4, page 40). In addition, the brigades will have an artillery battalion and a forward support battalion. The support assets in the support platoon of today's maneuver battalion will be located in the forward support battalion.

The intent of reducing the maneuver battalions from four to three companies and removing support assets from the maneuver battalion is to construct a more agile maneuver unit. Such an organization would be more capable of conducting the offensive operations required of the non-linear battlefield.

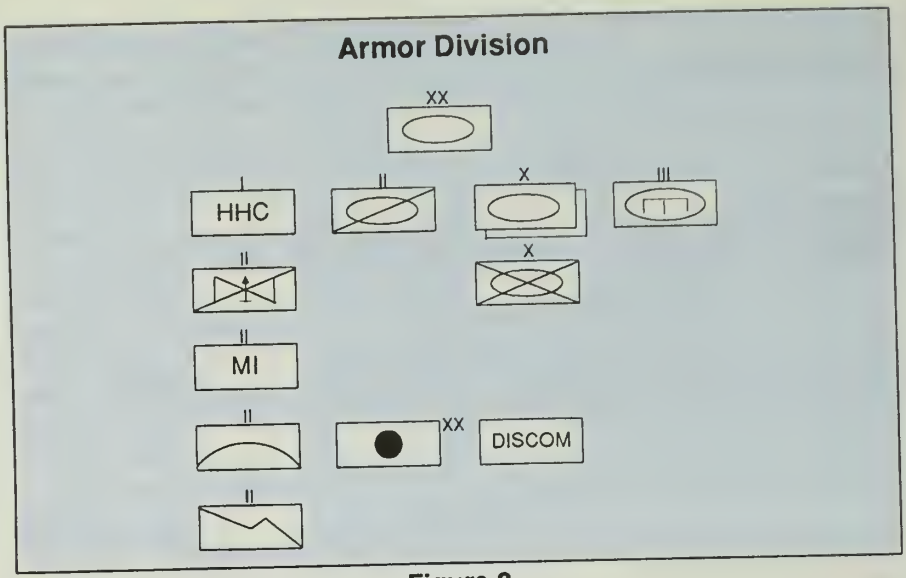


Figure 3

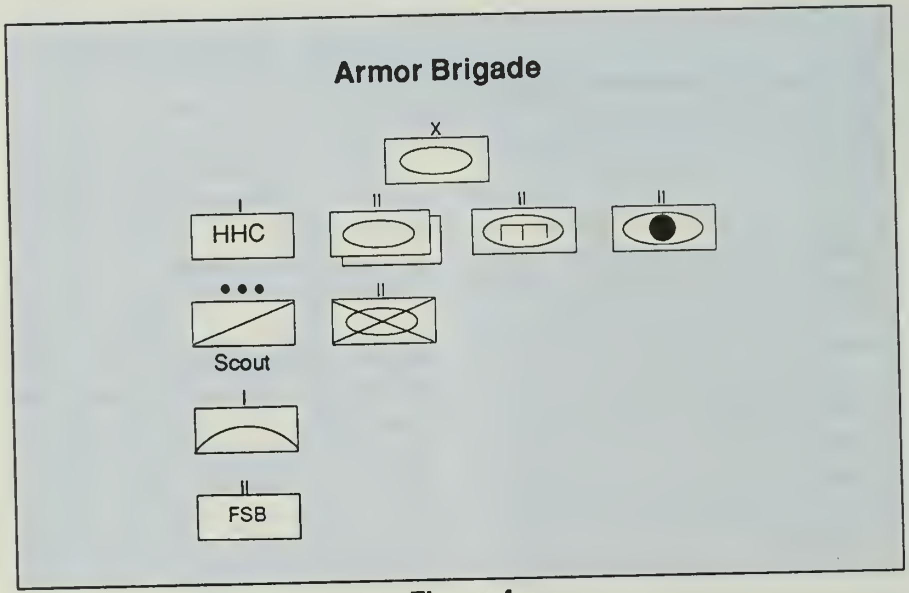


Figure 4

The challenge to engineers, then, is how to construct this type of unit. The necessary characteristics of such a unit are shown at Figure 5, page 41.

To meet the requirement necessitates a lean engineer battalion organic to the maneuver brigade (Figure 6). It is constructed to be 80 percent offense-oriented, with the remaining 20 percent geared toward countermobility.

An engineer platoon supports the maneuver company. This platoon consists of three squads and an assault section. This section has the capability to provide one in-stride breach. A company obstacle section has the capability to provide dynamic obstacles on the flanks, or reinforcing engagement areas with Volcano mines.

The battalion consists of three companies: one company in support of each maneuver battalion. The concept of an engineer battalion in support of a maneuver brigade was evaluated during REFORGER 90 by Training and Doctrine Command's Test and Experimentation Command. Results of that evaluation have shown that such support allowed greater flexibility to divisions and the corps, and served to increase their combat effectiveness. The combat multiplier effect of combat engineers was enhanced because engineers were better able to synchronize mobility, countermobility and survivability on the battlefield.

The corps commander conditions the enemy by separating him from follow-on forces by using RISTA and indirect fire assets. Massive indirect fires are used to destroy both enemy maneuver forces and fire support throughout the depth of the battlefield. This establishes the conditions for maneuver. At corps, the engineers must be able to provide mobility support to the RISTA elements that operate in or near the detection zone.

The corps artillery brigades will be deployed into the battle zone to destroy enemy forces at extended ranges. The key to the field artillery's survivability resides with their ability to be mobile. Hence, corps engineers will need to provide mobility support.

During the IPB process, topographic engineer support will provide the maneuver commander with the capability of "visualizing" the terrain. The IPB must be continually updated to indicate those areas that must be monitored to provide current target information for the attack systems. Terrain analysis will play a vital role in determining where those critical assets should be located on the battlefield. Shaping of the engagement areas—where decisive maneuver will take place—will be a corps engineer mission. These areas will be shaped by using dynamic and conventional obstacles.

A recap of the engineer capability available to corps includes mechanized and wheeled combat engineer battalions, combat support equipment companies, assault and fixed bridging companies, and a topographic engineer company. This capable mix of engineer assets, then, provides

ENGINEER

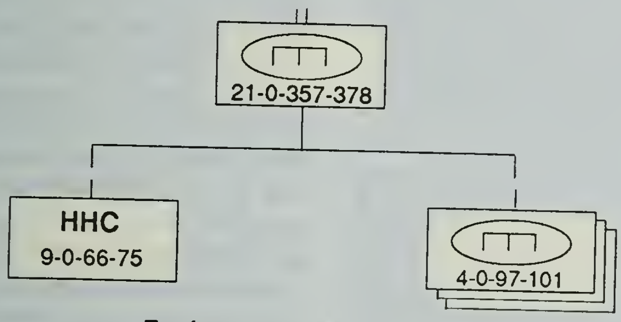
Challenge: *Construct an agile engineer organization that assures freedom to maneuver.*

Operational Characteristics:

- ***Enhance force lethality:*** Minimum of 2 in-stride breaches per task force.
- ***Enhance combined arms offensive operations:*** Shape engagement areas.
- ***Maintain force momentum:*** In-stride assault gap crossings.
- ***Agile organization:*** Offensively oriented; focused forward.
- ***Versatile:*** Rapidly reduce threat obstacles; dynamically emplace obstacles.
- ***Enhance maneuver:*** Timely analysis and dissemination of terrain data.
- ***Assure synchronization:*** C2 is centerpiece.
- ***Fight as infantry.***

Figure 5

AirLand Battle-Future



Equipment Recapitulation

28 - Armored carriers
3 - Carrier CP
12 - CMV
12 - HAB
12 - MICLIC
6 - VOLCANO
6 - M548
6 - HEMMT CGO
21 - ACE

Figure 6

the corps with significant flexibility to task organize on METT-T. It also provides the Army with a engineer force structure that will meet the tenants of AirLand Battle doctrine and the demands of any future battlefield.

Major Seerley is chief of Concepts Branch for the Engineer School's Directorate of Combat Developments. He previously served as lst Brigade engineer in the 2nd Infantry Division. He has also served on the Engineer Branch Assistance Team, Readiness Group, Denver. He holds a degree in civil engineering from the University of Southern California at Santa Barbara.

BOOK REVIEW

(Beginning with this issue, book reviews will be a regular feature in ENGINEER.)

Vietnam Studies, U.S. Army Engineers 1965-70, by Major General Robert R. Ploger, 240 pages, Department of Army, U.S. Government Printing Office, Washington, D.C. 1974.

This historic monograph is a tribute to the ingenuity and resourcefulness of engineer soldiers in overcoming difficult conditions to support the "man with the rifle." MG Ploger writes to capture lessons learned, help develop future concepts, and provide an historical record of the Corps of Engineers (COE) performance in South Vietnam (SVN) from 1965 through 1970.

Starting with troop buildup, the author cites early decisions made at the Executive level not to expand the Army by calling up reserves. This resulted in immediate active duty shortages in combat support and technical skills for the COE, stripped engineer equipment from reserves, and reduced CONUS and overseas tours to fill manpower and equipment needs in SVN.

MG Ploger chronicles the preparation for engineer operations in SVN with a common theme: too much to do with too few engineers. Engineer advisors played an important role early on by identifying construction needs and training SVN engineers. U.S. civilian contractors were successful during the period 1962-65 but, with the troop buildup, could only provide a stop-gap measure. In the author's opinion, "Army engineers were introduced at the latest possible moment that could permit success."

Challenges facing engineers dealt with building logistical facilities, ports, and base camps for follow-on divisions. They faced a new and difficult environment: heat, rainy seasons, lack of adequate roads, and aggregate needs. There are many stories of how engineers overcame the enemy and environment through innovative techniques.

The book concludes with an evaluation about dual staff and command responsibilities of the USARV Engineer, the value of engineer tasks, the engineer support system, and geographic area of responsibility. He leaves the reader with a challenge—to apply new developments to future conflicts and not to enter the next conflict prepared to fight the one before.

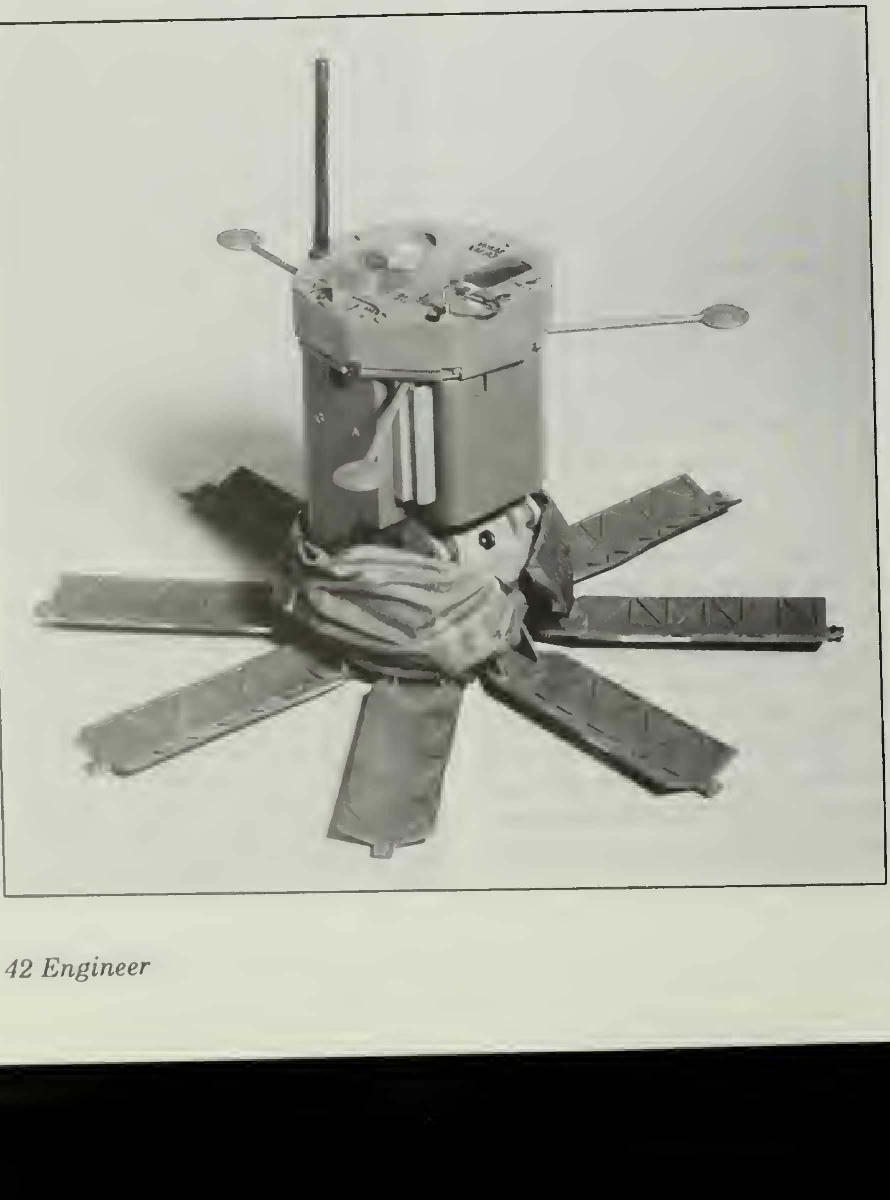
Early reports from Desert Shield indicate that today's military planners should have read Ploger's study. The implications of recent Desert Shield deployments to an inhospitable environment with little infrastructure has the makings of the initial deployment of forces to SVN. For the most part, however, Army engineers in SVN prepared logistical and support facilities prior to the arrival of combat forces.

LTC Ralph Grieco, Fort Leonard Wood.

Engineer Materiel Support for AirLand Battle-Future

By Charles Manning

AirLand Battle-Future (ALB-F) has emerged as the Army's basis for conducting combat operations into the 21st century. As ALB-F evolves, so does the Army's need to support the new doctrine by capitalizing on technology. To that end, the Engineer School has been identifying emerging technologies that might give tactical advantages to engineer forces. The school is also working to translate those technologies into functional, "real-world" systems for soldiers in the field.



Wide-area Mine

A few words of definition are in order to put this article in perspective. Emerging technologies are generally military-industrial fields in which significant advances are being made in the research and application of new electronic, mechanical or chemical knowledge. Emerging technologies may also be established industrial or scientific fields that have gained new relevance to Army operations.

This article is intended to give an overview of some of the systems expected to result from these technologies.

Countermobility

Developments in the area of microelectronics will provide the basis for advances in signal processing through the 21st century. And high speed circuits will play an especially important role in the development of countermobility systems for the Army.

The development of "very smart" processors has resulted in the ability of these processors to simultaneously handle two or more signals. These highly capable processors, which can also be programmed with artificial intelligence, are now being incorporated into small, autonomous systems like mines.

These "smart mines" will dramatically increase the complexity and lethality of land warfare. They will be able to detect, track, classify, select and engage targets from distances as great as 100 meters. This family of mines will utilize a variety of sensors to attack selected vehicles, helicopters, and even low-flying, fixed-wing aircraft. The mines will have a remote control capability for arming/disarming, and for system status reporting.

Binary agents and modernized initiators, while not new in civilian use, will also provide military engineers with safer, faster, and more efficient demolitions systems.

Mobility

Complementing progress in microelectronics is the continuing success of material and material-processing research, which holds great promise for the development of new structural systems.

Gap-crossing missions, in particular, stand to benefit from the development of new composite materials. Coupled with new manufacturing techniques, these composites will allow the development of more capable portable bridging systems. These bridges will have a greater load capability than current systems, and will need fewer personnel and transportation assets.

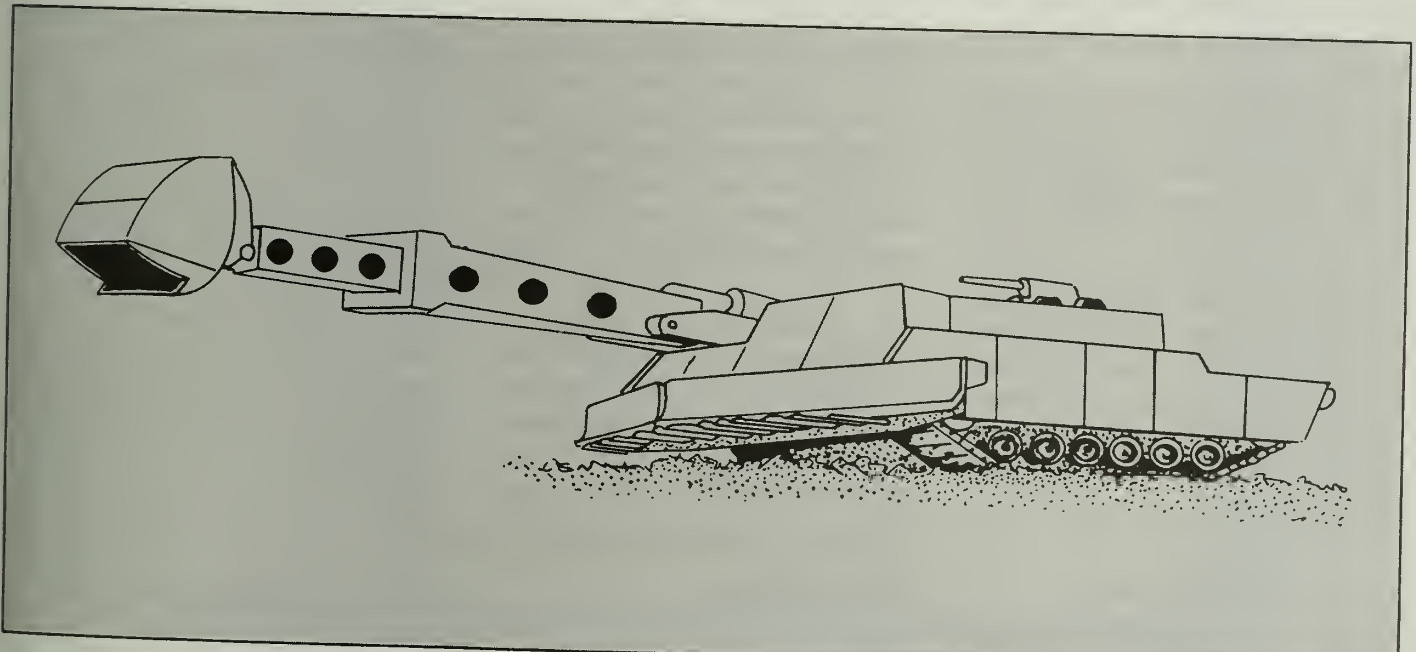
One composite bridge now in the works will be the heavy dry support bridge (HDSB), intended to replace medium girder bridges (MGB), Bailey bridges, and M4T6 bridging at corps. The HDSB will be a tactical bridge, capable of replacing assault bridging in forward areas and supplementing fixed and float bridging. It can be used as a follow up to the armored assault bridge, or as an alternative to the assault bridge when armor protection is not necessary. The rapid construction characteristics and wet gap span capacity (46 meters) of the HDSB will provide tactical commanders with a valuable asset well forward in the main battle area.

Countermine & Counterobstacle

The centerpiece of the Army's countermine/-counterobstacle program will be the combat mobility vehicle (CMV). The CMV will provide the combined arms team with a dedicated complex obstacle breacher that is as mobile and survivable as the supported force.

Another countermine program calls for replacement of the AN/PSS 11 mine detector. After years of frustration, this program is well along in the procurement process. The sapper squad set is now being fielded, along with a mine rake for the combat engineer vehicle (CEV). The rake saw its debut during the Gulf War.

Advancements in ballistics and warhead design have led to a development program for a small, man-portable "bunker buster" weapon. This weapon would be available to sappers for reducing obstacles and defeating fortifications.



CMV Conceptual Design

Topography

For the Army, the use of space technology to support military operations is an old endeavor with new promise.

The Terra Geode program, sponsored by the U.S. Army Engineer School, will evaluate the potential value of an Army astronaut. With expertise in geology and military tactics, the engineer astronaut would observe important maneuver areas while his spacecraft was in low earth orbit. His observations would make a significant contribution to mobility planning for tactical forces.

The Military Man in Space (MMIS) program was initiated in 1986 as a Department of Defense project. The objective of MMIS is to provide an opportunity for the armed services to study the usefulness of having military astronauts support combat operations.

Other topography programs included the maneuver control system-engineer (MCS-ENG), which will provide automated command and control for engineer commanders and staffs. It will also provide engineers with access to maneuver unit data, and vice versa.

The digital cartographic system (DCAS) is a tactical computer-based system which will automate many Army cartographic functions. It will receive, reformat, create, store, retrieve, update, manipulate and densify digital topographic data. DCAS will also give data to the digital topographic support system (DTSS) and other tactical systems which need digital data and products.

Sustainment

Engineer sustainment capabilities will be improved through advances in commercial construction equipment. New Army systems include the hydraulic excavator (HYEX) and the interchangeable pad compactor (IPC).

The HYEX will be a diesel-driven, tracked vehicle, with a hydraulically operated extendable boom—or knuckle boom—with an excavating ripper bucket. Attachments for the HYEX will include a hydraulic slide angle or versa-link quick-change coupler system for a hydraulic impact hammer, vibratory plate compactor, multi-purpose jaw, or a finger bucket. The HYEX will be capable of mass excavation, lifting, mass loading, grappling, compacting, and breaking or shearing concrete, rubble and rock.

The IPC is a self-propelled compactor with removable pad feet that provide greater flexibility and compaction capabilities. Because of its interchangeable feet, the IPC will be capable of smooth-drum rolling, and compacting both cohesive (clays) and non-cohesive (sands and gravel) materials.

These are just a few of the many technological developments on the horizon that will lead to more capable engineer units for AirLand Battle-Future. In the not-so-distant future, emerging technologies will vastly improve our capabilities, while reducing logistic and personnel requirements.

Mr. Manning is a Manprint and Integrated Logistics Support Analyst for the Engineer School's Directorate of Combat Developments. He is a former infantry officer and Army aviator. He holds a degree in psychology from the University of South Florida.

(Personal Viewpoint continued)

various assets for a particular course only when needed.

Can soldiers learn a new MOS, to the standards of resident instruction, in only two weeks? Yes, when the POIs are very intensive! In his article "MOS Qualification in the Pacific," (pages 17-19), Captain Bowers explains how it can be done. He describes how AC and RC units and the Engineer School combined efforts to conduct reclassification training for 51B, 62E and 62J MOS. Significant cost savings resulted from reduced travel expenses and a condensed training period: two weeks, plus weekend classes and correspondence courses.

Some MOS reclassification courses may require 135 hours of training in the two weeks; a 10-12 hour day is the norm. The training day is all MOS specific, with emphasis on hands-on, equipment-intensive training. To be successful, soldiers must arrive ready to train, with appropriate equipment, within weight standards, and be physically fit.

The caveat of this article is that we should debate how to best reclassify NCOs into the engineer MOS. There is precedence of AC officers commuting to the closest RCTI to complete the Command and General Staff College. Should AC reclassified NCOs have the same option?

The real test of the RC engineer reclassification courses may be the success of course graduates who participated in Desert Storm. If RC engineer NCO reclassification courses successfully prepared RC engineers for war, they should be considered to reclassify all NCOs in peacetime.

Major Davison is Chief of the RC Training Office, in the Engineer School's Directorate of Training and Doctrine. He has commanded AC and RC units, and served in engineer staff positions and as an ROTC instructor.

Engineer Solution

POSSIBLE SCHEME OF ENGINEER OPERATIONS

This possible scheme of engineer operations supports the maneuver plan.

Phase 1. Mine plows in the support force will provide mobility assets for a TF in-stride breach if that is required. The breach force is prepared to transition to a deliberate breach.

Phase 2. The priority of engineer effort is to the deliberate breach of the complex obstacle. The breach force provides two lanes, seizes a foothold on Obj Pit, and tactically marks the lanes.

Phase 3. The priority of effort is first to provide engineer support for the assault force as they assault to secure the trench line (Obj Pit). Then, the engineers' effort shifts to completing tactical lane marking.

Phase 4. Priority of support is first to assure passage of the support force through the lanes. Then the engineers provide mobility along Axis Lead to BP 10. The allocation of mobility assets is shown below, in Figure 5.

When planning engineer support for this deliberate attack, you must first consider engineer support to reconnaissance efforts. Reconnaissance is an essential engineer task, but it will not be covered in detail in this situation. Even though the task force was given hard intelligence on the enemy, you must conduct reconnaissance to confirm or deny the information provided.

At a minimum, the task force will conduct reconnaissance and surveillance of Axis Jab, part of the complex obstacle (into the first minefield), and enemy positions and weapon systems in the trench line (Obj Pit). One or more sapper squads will work with the scouts, concentrating on the complex obstacle.

Other major considerations should become apparent as you develop a scheme of engineer operations, working from the LD/LC to BP 10:

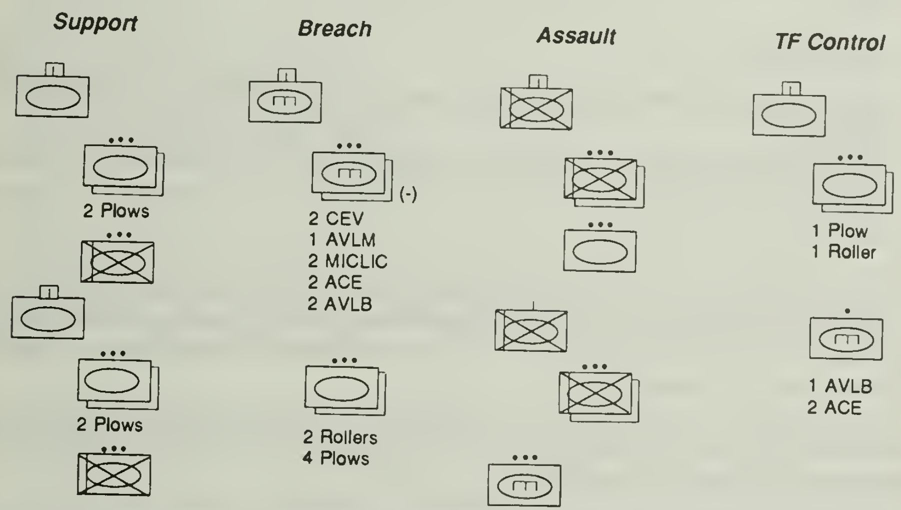


Figure 5. Task Force Task Organization

Engineer Solution

Support to movement along Axis Jab. Even though the task force does not expect to encounter obstacles along Axis Jab, you should provide sufficient mobility assets to the support force so they can conduct in-stride breaches. These breaches will maintain the attack's momentum.

Because the task force will attack in a modified VEE formation, the two tank teams in the support force must maintain control of the mobility assets. Each team has two mine plows, which should provide the assets needed to breach any weak or lightly defended obstacles. Obstacles are not expected, so it is reasonable to assume these plows will be available to provide mobility for the support force in phase 4.

Although the breach force has the assets needed for a deliberate breach, you do not want to launch into one before reaching the complex obstacle. The assets provided the lead element should preclude this.

Support to the Breach. The breach force must provide two lanes through the complex obstacle and mark the lanes. Consider the following requirements when determining the assets needed for *each lane:*

- Mobility assets required to reduce the complex obstacle, plus 50 percent more for redundancy
- One engineer platoon leader to provide control
- At least one sapper squad to mark the lane

The breach force is a combined arms force that is tasked to reduce the obstacle and provide local suppression and security. Maneuver forces task organized to the breach force are the first to assault through the lanes to gain a foothold on Obj Pit. The following mobility assets are required for each lane to reduce the complex obstacle:

- Two MICLICs
- Two proofing vehicles (CEV with mine rake, roller, or plow to proof the MICLIC paths)
- One AVLM or two prime movers to pull the MICLICs. If an AVLM is not available, use a CEV
- One fascine or one AVLB

An engineer platoon leader controls the assets for each lane; one sapper squad is required to mark each lane. The 50 percent redundancy per lane is provided by one plow, one ACE, one AVLB, and one sapper squad. Review Figure 5 for task organization of the breach force.

The maneuver assets provide local suppression and security when they are not committed to breaching. They are organized to secure the far side of each breach lane when the obstacle is reduced.

Support to the assault force. The assault force must secure two enemy platoon

Engineer Solution

trench lines. Infantry platoons are capable of conducting assault breaches, but you can increase the assault breach and bunker destruction capabilities by task organizing sappers to the assault force. Thus, you will task organize one engineer platoon to the assault force.

Support on Axis Lead to BP 10. Although obstacles are not expected, the enemy has scatterable mine capability which he can employ on Axis Lead. The support force has a total of four plows for independent breaching operations. And the TF reserve, not yet committed, has mobility assets that can supply this support: one roller, one plow, one sapper squad, one AVLB, and two ACEs. It is unreasonable to expect a change in task organization after phase 3 to provide sappers from the breach force to the support force.

- - - - - - -

The Deliberate Breach

Definition: A unit conducts a deliberate breach when the force allocation ratios for support, breach, and assault forces are beyond the capability of a task-organized subordinate unit.

The commander uses a deliberate breach when...

- The unit fails an attempted in-stride breach of enemy tactical obstacles.
- Force allocation ratios indicate that a confirmed enemy situation (strong defense and/or complex obstacles) is beyond the capability of a subordinate unit.

Some Characteristics:

- A deliberate breach requires detailed reconnaissance, exhaustive combined arms rehearsals, and overwhelming suppression of the enemy's overwatching direct fire weapons and indirect fire systems before beginning obstacle reduction.
- A deliberate breach is centrally planned and executed.
- One or more subordinate units are specifically tasked to perform the role of support, breach, and assault forces.
- The breaching tenet of mass drives task organization. For example, the breach force has the bulk of mobility assets and is tailored to counter a specific type of obstacle(s). Direct and indirect fire systems are massed in the support force in order to provide necessary suppression. Forces required are massed into the assault force to secure the far side of the obstacle or the objective.
- The breach force is organized and equipped to use several different reduction techniques in case the primary technique fails. Additional reduction assets are allocated to handle the unexpected. Normally, 50 percent more assets than those required are positioned with the breach force.

- - - - - - -

This Engineer Problem was submitted by Captain Tom Kula, currently serving as an instructor/writer at the U.S. Army Engineer School, Department of Combined Arms. He is a graduate of the U.S. Military Academy and the Infantry Advanced Course, and has served as an observer/controller at the Joint Readiness Training Center.

Engineer Brigade Initiatives for Desert Shield

The 20th Engineer Brigade (Airborne) was approaching the end of a corps field training exercise last summer, when the brigade S-2 walked into the TOC (tactical operations center) and handed the commander a message.

Up to that point, all such messages were simulated world situation updates, based on the exercise scenario. But this message was real.

The document read in part: "Iraqi forces are threatening to invade the oil-rich emirate of Kuwait." While the brigade went through its normal redeployment, the strained situation in the Persian Gulf worsened. On arrival at home station, soldiers of the brigade offloaded vehicles, topped off fuel tanks, and secured their weapons and equipment. At the same time, though, unit leaders were being informed that they would soon be turning their attention from field recovery to preparation for deployment to war.

Within days Iraq invaded Kuwait, and threatened to continue advancing into Saudi Arabia. As political powers began maneuvering to neutralize further aggression and seek a peaceful solution to the problem, the Army initiated preparations for war.

After a series of daily corps update briefings on the current situation in the Gulf, the brigade was given an on-order mission to deploy by both sea and air to Southwest Asia. On arrival, it would be responsible for the five engineer battlefield missions: mobility, countermobility, survivability, sustainment, and topographic engineering. The gravity of the developing situation spurred the brigade staff as they developed their mission analysis and engineer estimate.

Simultaneously, the brigade reviewed its concept of how to best support maneuver commanders once the unit was in theater. We thought it might be useful to share some of the initiatives taken by the brigade to make sure that it was prepared to meet that mission. These included personnel and equipment augmentation; updated training on engineer doctrine, tactics, techniques, and procedures; and coordination meetings with downtrace unit

By Colonel Robert B. Flowers & Lieutenant Colonel James E. Meredith to quickly disseminate needed information.

The brigade called on other organizations for assistance in gearing up for the deployment, including the Engineer School, the Belvoir Research, Development and Engineering Center, the Civil Engineer Research Laboratory, and the Defense Mapping Agency. All these agencies were extremely helpful in providing support for the unit.

Personnel

In preparing for deployment, our first move was to request personnel augmentation. Many engineer units were to be task organized under the brigade headquarters, increasing its size up to five times normal strength. Such a drastic increase in personnel necessitated a similar increase in the size of the staff. Specific augmentations included personnel and administration specialists, intelligence analysts, construction supervisors, soil analysts, and Class IV construction material management specialists. Additionally, facility specialists were needed to augment the Corps Engineer section. This section would be responsible for managing real estate actions and overseeing fire protection throughout the theater of operations.

Equipment

Our request for equipment augmentation emphasized mobility and countermobility in desert operations. This meant additional ground emplaced mine scattering systems (GEMSS), and armored combat earthmovers (ACE). The GEMSS, a towed mechanical mine dispenser, is used by engineers in the main and rear battle areas to emplace large tactical minefields. The ACE is a highly mobile, armored, amphibious combat earthmover capable of speeds up to 30 miles per hour. The Engineer School offered their 13 ACEs, and coordinated the use of eight more from the National Training Center. The Engineer School also initiated coordination for getting 16 additional GEMSS from Europe-based units.

> **"With a few pre-deployment and in-theater initiatives... engineers can maximize their value to maneuver forces..."**

MTTs

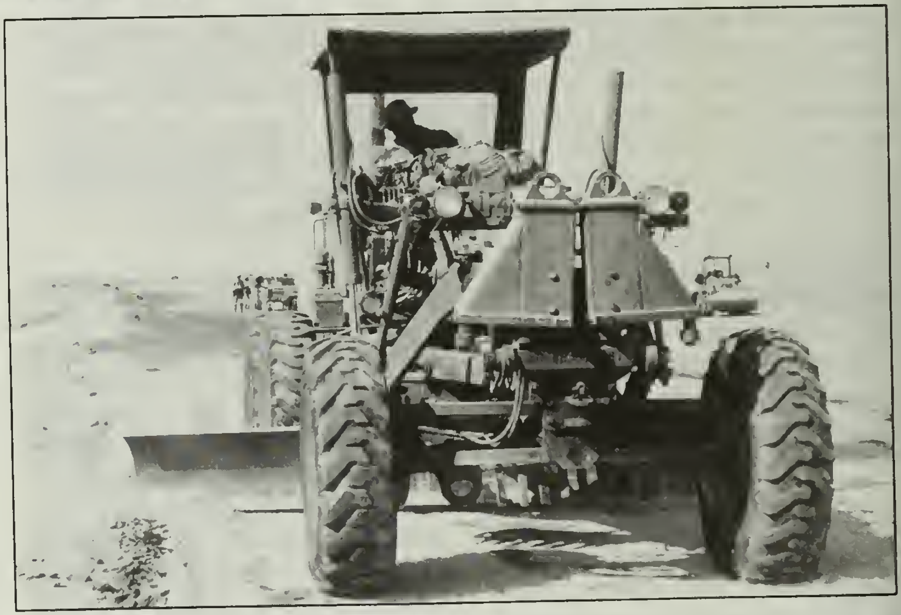
Our next step was to request the assistance of a Mobile Training Team (MTT). Training was to be conducted in two phases—predeployment and post-deployment. Prior to our deployment, the Engineer School sent an MTT to update our units on tactical and other engineer subjects. The tactics portion was designed to "train the trainer" on threat, AirLand Battle, engineer estimates, offense, breaching, defense, obstacle synchronization, and lessons learned during light and heavy desert operations. Also included was combat engineer instruction on demolitions, survivability positions, and emplacing/breaching minefields. Construction tips on drainage, dust palliatives, and airfield and main supply route maintenance were also part of the instruction.

Mines

We also wanted to give our soldiers better knowledge of the type of mines they would encounter in Southwest Asia. A subject matter expert (SME) on Iraqi mines was provided by the Belvoir Research, Development, and Engineering Center. His instruction was extremely valuable. Many mines currently in use by the Iraqi army were purchased from Italy, and the familiarization with these mines was sorely needed by most of our soldiers. The SME also deployed to Saudi Arabia with us, and continued to be available for advice and assistance to all in-country engineer units.

Construction Management

Massive requirements for combat construction support were anticipated early in the deployment. To help manage these projects, the Civil Engineering Research Laboratory assisted us by providing a Theater Construction Management System (TCMS). This included a current state-of-the-art personal computer system designed around the AUTOCAD software system. The TCMS allowed the brigade to maintain accountability for construction materials, and personnel and equipment hours. It also helped us track project status for about 1,000 newly cleared miles of desert roads, more than 1,000 helicopter pads, and untold tons on bulldozed soil used for protective berms.



Top and above: **One of the 20th Brigade's initiatives included building access trails and protective berms for maneuver units.**

When time and manpower permitted, these projects were sandwiched in between a tremendous list of higher-priority missions.

Topography

At the start of Desert Shield, significant portions of the expected area of operations had not been mapped. To help alleviate this problem, a tactical terrain exploitation cell (TTEC) was developed by the brigade in close coordination with the Defense Mapping Agency. This system linked real-time imagery to the map production process. The advent of TTEC allowed topographic production specialists to provide the most up-to-date map products available. Given to the maneuver units, the maps allowed commanders to make the best possible use of the desert terrain.

Construction

With heavily competing priorities for cargo shipments, the brigade anticipated significant delays in receiving Class IV material once in theater. To satisfy maneuver commanders' initial demands for base camps, the brigade ordered one million sand bags for rudimentary construction. Next, the brigade requisitioned six 2,500-man base camp packages using the Army Facilities Components System (AFCS). AFCS provides construction units with the plans, bills of material, standards for construction, labor and equipment, and material shipping estimates. Requirements for airfield construction and repair also prompted us to order M2, M18, and M19 airfield matting, geotextile, and sandgrid.

Deployment

With initial preparation initiatives completed or well under way, our units began deploying to the Gulf theater on 21 August 1990, in accordance with the time phased force deployment list. Once on the ground, they were faced with the immense task of identifying unit beddown sites. This was a monumental task, considering that the area of operations equated to an area the size of Missouri and half of Iowa.

Initially, engineers were given limited combat engineer missions because of political sensitivities. Consequently, engineers received a large number of construction missions.

Before launching into construction projects, the brigade took some advice from Field Marshal Erwin Rommel. During World War II, he said, in essence, that before you can defeat the enemy, you must defeat the desert. Extensive leader reconnaissance was conducted in the area of operations.

The brigade then coordinated with the Mideast Africa Project Office (MEAPO) of the Corps of Engineers. MEAPO arranged for us to work with host nation support engineers and observe construction practices commonly used in Saudi Arabia. Among these practices were the use of sprayed diesel fuel as a dust palliative on compacted sand roadways; using marl, a chalky material similar to concrete; and placing a 1.5 percent slope on roads to prevent the buildup of drifting sand.

It wasn't long before we realized that we had more combat construction missions than we could handle, given limited equipment, personnel, and time constraints.

One solution chosen by the brigade was the use of host nation support contract construction equipment. Specific equipment shortages included compactors, water distributors, and dump trucks.

Setting priorities also helped. Construction priority went, in order, to M19 matting for helicopter pads; construction and maintenance of main and alternate supply routes, construction of ammunition supply points and tactical petroleum terminals; force protection, and life support areas (base camps). To help maneuver units as much as possible, "good neighbor" projects like access trails and protective berms were completed when time and manpower permitted.

Combat Engineering

While the greatest engineer effort was initially construction, combat engineers needed to train for expected hostilities. The primary focus of this training was mine and countermine warfare. Our personnel participated in combined arms breaching exercises with their respective maneuver units, with emphasis on synchronization of support forces, breach forces, and assault forces.

Brigade engineers also trained alongside Saudi engineers, with the help of translators, again with an emphasis on mine warfare.

A decade ago, military planners were frustrated with the multitude of challenges facing them in a potential Mideast military confrontation. The region's austere landscape and climate poses unique challenges, including sand and dust, logistical resupply over great distances, and force protection in largely open and barren terrain.

The National Training Center had been a great help in familiarizing soldiers with some aspects of desert warfare. The California desert also helped to precision-tune improvements in engineer doctrine, force structure, and force modernization.

Today, Desert Shield and Desert Storm have validated engineers as key players in the synchronization of battlefield operating systems. With a few pre-deployment and in-theater initiatives like those practiced by the 20th Brigade, engineers can maximize their value to maneuver forces even further.

Colonel Flowers is commander of the 20th Engineer Brigade, now deployed in Saudi Arabia. He previously served as commander of the 307th Engineer Battalion (Airborne) at Fort Bragg. Other assignments include battalion XO and S-3, project manager for the Portland Engineer District, and various command and staff positions with the 94th Engineer Battalion. He is a graduate of Virginia Military Institute, and holds a masters degree in civil engineering from the University of Virginia. He is a registered professional engineer in Virginia.

Lieutenant Colonel Meredith is deputy brigade commander of the 20th. He previously served as assistant corps engineer for XVIII Airborne Corps. Other assignments include battalion XO and assistant division engineer with the 101st Airborne Division (Air Assault), and various command and staff positions with the 54th and 317th Engineer Battalions. He is a graduate of the University of Kansas, and holds a masters degree in military art and science.

LESSONS LEARNED

The Engineer Estimate

The following Lessons Learned applies to the engineer estimate process. It is derived from after action reports (AAR) submitted by the National Training Center (NTC) and Joint Readiness Training Center JRTC), and is in the engineer lessons learned data base. For more information, write to Commandant, U.S. Army Engineer School, ATTN: ATSE-ESA-L, Fort Leonard Wood, Mo. 65473-6630. Or, call (314) 563-5321/5317, Autovon 676-5321/5317.

ISSUE: Lessons learned from NTC and JRTC show that the engineer estimate process is often employed poorly or is so highly abbreviated that it is ineffective. Comments from training units state that soldiers think the process is "too hard" to use.

DISCUSSION: Evaluation of this problem reveals the need for a sound doctrinal approach to the engineer estimate process. Comments from AARs focus on the failure of engineers to coordinate planning within the combined arms team decision-making cycle.

Analysis of AARs and comments from the field suggest there is a problem with synchronization between the brigade and task force engineer, and between the maneuver brigade and task force staff and commander. Specifically, the following disconnects occur:

- Engineers often are not included with scout reconnaissance patrols to gather obstacle intelligence (OBSINTEL) data.
- Engineer input to the S-2 for the intelligence preparation of the battlefield (IPB) is poor when engineers are not included in this reconnaissance.
- Terrain analysis, vital to the IPB and wargaming of alternative courses of action, is weak when "engineer" eyes are missing from the battlefield.
- Engineers often do not play an active role in wargaming courses of action with the brigade and task force staff. Thus, the critical coordination required to put engineers in the right place at the right time with the right resources is reduced, making it difficult to execute the scheme of maneuver and effect the commanders' intent.

The Engineer School's Department of Combined Arms suggests that this deficiency also occurs because—

- The engineer estimate described in FM 5-100, Appendix B, only addresses the written estimate product, not how it integrates with the command estimate.
- The engineer estimate, in relation to the command estimate, was not reinforced with practical exercises in the Engineer Officer Basic and Advanced Courses (EOBC and EOAC).
- The command estimate and the engineer estimate were not integrated until January 1990, when they were incorporated into the EOBC and EOAC program of instruction.
- Observers and controllers at NTC and JRTC have received doctrinal updates from the Engineer School faster than units in the field. This results in a training "void" for engineers when units arrive to train.

RECOMMENDATION: The Engineer School proposes two related strategies to fix the synchronization problem and enhance the estimate process. The first is a focused approach to the estimate process, and the second is a strategy to integrate the engineer staff officer into the brigade and task force staff planning process. We call them ***What to Do*** and ***When to be There.***

On the surface, the engineer estimate is a complex but workable process. When the process is evaluated using METT-T (mission, enemy, terrain, troops, and time available), the complexity varies as a function of mission and time available. Missions may be complex (i.e., river crossing operations) or fairly simple (i.e., dig a vehicle fighting position). Having more time available for estimating allows the development of more detailed and complex plans.

We do not propose changing the process; it is effective and thorough. Every engineer officer must know it. Our strategies for "What to Do" and "When to be There" provide a clear focus and a clean snapshot of the essentials.

WHAT TO DO.

The estimate is built around two related perspectives: How the battlefield will affect engineer forces, and how engineers can influence the battlefield for each proposed maneuver course of action.

Engineers must provide the maneuver staff and

By Captain James R. Brannon and Mr. Vernon L. Lowrey commander with at least the following information, which should be analyzed in the order given:

a. Engineer Battlefield Assessment

1. How terrain and weather will influence proposed operations. Can you move your equipment (roads); expected weather impacts (trafficability); expected terrain impacts (use OCOKA—will it force your hand or can you influence terrain to your advantage?).
2. Enemy engineer capability and how you expect that capability to be used (countermine/counterobstacle, tactics, and techniques).
3. What resources (equipment, personnel, supplies) you have, what you can do with them, and what you require for those options that exceed your capabilities.
4. Quantity, type, and location of available engineer class IV and V supplies. Also, the number and type of engineer units and equipment available in the area, and the number and type of combat support units available to assist.

b. Analysis of Maneuver Courses of Action

1. Propose an engineer plan for each maneuver course of action (SPEAK UP!), note your needs, resources, priorities, and forces employed.
2. Compare your courses of action, choose and recommend the best one to the maneuver staff.

These are the basic essentials of an engineer estimate.

The next step is to wargame your engineer courses of action with the maneuver staff. Eventually the staff will brief the commander on two or three courses of action and will recommend one.

Your role, as the engineer, is to influence that decision-making process during wargaming. For example, the staff may favor (in order), plans A, B, and then C, while the engineer preference is B, C, and then A. In that case, you must tell the maneuver commander—

- How the engineers will support his choice
- Why you prefer the other choice
- What limitations you face
- What resources you need to make his plan work
- What actions you recommend to eliminate or reduce any deficiencies

Engineer execution matrices are helpful when you prepare an estimate (an example is shown on page 32, in the July 1990 issue of *ENGINEER Professional Bulletin*). Matrices assist the engineer when setting priorities for missions, determining task organizations, and getting supplies.

In a very small nutshell, the "What to Do" will enable you to synchronize the engineer estimate with the combined arms team.

When to be There. The best plan is worthless if it is delivered too late. Your role in supporting the maneuver commander demands that you be present at critical times, i.e. for—

- Receipt of the brigade or task force warning order
- Initial leader's reconnaissance
- Face-to-face discussions with brigade or task force S-3 during wargaming
- Commander's guidance and decision
- Commander's final reconnaissance (i.e. siting obstacles, defense)
- Preparation of the brigade or task force operations order
- Preparation of the company team operations order, when they are in the attack

This is a minimum list of critical times. The bottom line is, you must be there—to hear and be heard. Being there, personally, may be logistically difficult and will certainly require that sub-units receive appropriate warning and guidance to prepare for operations.

Your unit's standing operating procedure (SOP) must anticipate task organization and instructions for delegating critical tasks. Because you cannot be everywhere at once, squad leaders, platoon sergeants, platoon leaders, and first sergeants must know their tasks and task deadlines in advance. This will allow you time to be with the maneuver staff engineer.

You may sometimes feel unwelcome or be overtly neglected by maneuver unit leaders. Such problems can prevent the engineer process from happening. Your job is to work through these problems to ensure engineer issues are raised and acted upon in time to influence mission success.

Current force structure initiatives should resolve most of these integration difficulties because they allow habitual association between maneuver and supporting engineer forces. Until these changes occur in your unit, stay with the team. Know your maneuver commander's intent and know the enemy. Tell the maneuver commander what you can and will do to support his plan. Tell him what the enemy can be expected to do and what you will do to counter that threat and enhance the scheme of maneuver.

The engineer estimate process is now reinforced at the Engineer School in every tactical exercise without troops, practical exercise, and classroom tactical instruction. It provides the best framework for effective staff planning. For maximum efficiency and effectiveness, the process must be trained, practiced, and become "rote" to all engineers. Use it with success.

Can You Hear Me, Lieutenant?

By Lieutenant Colonel Herb Harback

> **"As a platoon leader, you are the caretaker of those sons and daughters of America. It is the most awesome of responsibilities..."**

The Army War College has provided me too much time to think about Desert Storm. I wish I was there instead of on the side lines. Sure, I want to be there in the desert with "my team," but there is another reason. I trained many of those combat engineers. They were my responsibility and now they are there and I am here. I wish I had the chance to just check them out one more time; double check the gear, the plans and a quick rehearsal. To sit down with the junior leaders and have them brief back to me all we have discussed over the years; to sit down with the newest of the leaders and go over essential leadership traits. I want to talk with each of these warriors.

Most of all I need to share my thoughts with the platoon leader. But the best I can do now is to send him a note.

Can you hear me, Lieutenant? I know you're saying to yourself "why should I read this?" And that's a legitimate question. Your time is very valuable. You have a whole platoon of challenges awaiting. You have things to do, places to go and people to see. As a lieutenant in the United States Army you have been trained and tested; it's time to take charge. I ask of you to read these words and capture the spirit within them.

First, what I have to say concerns soldiers. As a platoon leader, you are the caretaker of those sons and daughters of America. It is the most awesome of responsibilities; far greater than anything you have done before now. Hear my words so you will do better than I.

A young officer once came up to a great soldier and asked that proven warrior how he became such a great leader. The general looked at the soldier and replied, "That is easy. Two words sum it all up—right decisions." The soldier thought about that and then asked, "How do you make right decisions?" The leader replied, "Easy. One word sums it up quite nicely—experience." The young soldier thought about that and then asked, "But how does one get that type of experience?" The general smiled and said, "Two words—wrong decisions."

I will tell you, though, that there is not enough time for you to personally experience it all. If you are to be the leader we expect of you, then the experience—the "wrong decisions" the general was talking about—

must come from others as well as yourself. Listen and learn from my mistakes and experiences.

The other reason why you should read on is more pragmatic. The Army is entering into a major reduction of force. The majority of ROTC cadets, even those with scholarships, will not be allowed to enter into the active service. Many young officers on active duty, and with positive mission accomplishments to their credit, will be asked to leave. The cut line between who stays and who goes will be tough. It pays to listen and learn from an officer who experienced four such troop reductions.

I would like to talk with you about what I expect from you as an officer, platoon leader, and fellow soldier. What I say are simple words of advice from a soldier who has taken a number of wrong turns, had some great luck, all kinds of bosses, and learned from myself and others.

There are ten soldier traits you must internalize. They must be a part of your being, each and every day. You are about to enter into a profession like no other calling. You will be given the responsibility of protecting our nation, and, on a daily basis, the well being of a priceless team of young warriors.

1. Soldier Concern—Your soldiers are your 24-hours-a-day responsibility. This is not an 8-to-5 job; it is a calling in the purest of senses; total commitment to your men and women and their families is your purpose.

2. Sustainment—The green machine is not a perpetual one; it is fleeting in its vision and strength. You must constantly work at sustaining the excellence of your soldiers and their equipment; keeping it all together and focused for the long haul. Sustainment means dedication and selflessness, each and every day.

3. Fitness—Physical, mental and moral strength is what I'm talking about. Your body, mind and spirit will be asked to perform when your senses tell you to drop out, to quit. You must have the physical strength to go the extra mile, and the moral fiber to maintain the battle vision. You must have the mental clarity and agility to put it all together, day and night; not only for yourself, but for the soldiers whom you lead. "Hanging tough" is what I expect of you, and it all starts with a physically fit body. If you don't have it now, you probably won't have it later, and it is during combat that you will be asked to do the near impossible. If you don't have what it takes now, I can't risk waiting too much longer for you to obtain that special spirit.

4. Training—It is a mindset. When Juma Ikangaa of Tanzania, the great marathon runner, was asked about his world record in the New York Marathon, he said, "The will to win is nothing without the will to train." Soloflex Corporation prints it on their T-shirts—"No Pain, No Gain." You must live, eat and breathe a training experience mentality. All you do must be training related. You must have that focus. When we are called, the nation will expect us to be trained, and our soldiers will have worked hard doing those things you have ordered them to do in the name of training opportunities. There will no longer be any time to train. It will be a time to execute.

5. Safety—Goes hand-in-glove with training. All actions involving your soldiers must consider safety. It is the essence of true soldier concern. You must understand and practice risk analysis, which leads to the reduction of the inherent dangers found within realistic training. Do not assume anything when it comes to safety.

6. Soldier Recognition And Retention—Are essential within our calling. We must always be in tune with our soldiers and recognize them for their actions—both the good and the bad. A hand-written note performs miracles. It shows that you really do care by walking the extra distance to give a "thanks" or a "get with it," not only to the soldier, but to the spouse or parents. Give them the self-worth and feedback they deserve and seek.

That leads to soldier retention. Retention is your duty and it starts on day one, when you welcome the troop into the unit. We recruit the individual, but we retain the soldier and his family. Remember that.

7. Responsibility, Authority And Accountability—It is, in leadership terms, the "powering down" to the lowest level which can successfully accomplish the mission. If it's a squad's job, then give the torch to the squad leader. You power down to the mission, giving that soldier the responsibility and authority do to it; don't forget the third part of this tenet—accountability. Make sure all know that along with powering down comes accountability for one's actions.

8. Professional Development—Is expected of you from the get-go. You are in the profession of arms and must maintain proficiency and competency in your calling. This does not mean that you immediately enroll in night classes for an MBA, rather it means you focus on your military growth and the growth of your soldiers.

9. Battle Focus—It is critical that you understand and maintain a clear and present battle focus in all you do. Successful deterrence comes from a persistent, full-court-press type of battlefield awareness. That is hard to do. It means that you understand what this calling is about, you have taken your oath seriously, and no matter what external factors may impact upon you, you will keep yourself and your soldiers locked-in on target, every single day.

10. Finally, there is Leadership—Leaders are made, not born. They are developed through themselves and others. Operation Desert Storm will be seen as a success or a failure depending on the actions of front line, troop level, leaders. Proper leadership is done in three phases: you listen, learn and then lead. Listen, learn and lead—in that order. Change it around and you have a mess. You must listen before you can learn, and you must learn before you can lead.

"Leaders follow" is a simple, yet complex, old saying. It means that leaders follow-up, follow-through, and follow the lead. When I came into the Army, "manager" was a bad word. The Army only had leaders, not managers. Of course, that was one of the major problems with the Army since, in reality, each officer must be both manager and leader.

A manager focuses on sustainment; he is concerned with the efficient running of the organization. The leader, though, is more focused on the forward movement of the organization; he is concerned with mission accomplishment. Leadership, true leadership, demands both.

These ten tenets are your foundations. Each one is critical in itself. But all can be rolled up for you, the professional soldier, into three basic traits—*caring, standards, and readiness.*

When it comes to caring, there are three questions one must ask oneself about each of his soldiers: Who is he? How is he? Where is he? Caring is not being soft; it's being firm.

The first soldier to die during Operation Just Cause was one of mine. He was a great soldier who I cared for very much but maybe not enough. The Panama crisis was developing when this soldier asked for time off. We were totally wrapped up in getting the division and ourselves ready for anything and no one was allowed to go on leave, but we said "yes" to this fine soldier.

Then Just Cause started. Our initial mission was to outload the division, and we forgot about the soldier; we stopped caring for him for a few days. This first soldier to die was shot in the head with a .357 magnum; the bullet entered and never exited his skull. They say it was a lover's quarrel. It was just outside our post.

Caring is a full time mission for each of us. "Who is he?" His background, desires, needs, loved ones are more than just a name, he is soldier you have been entrusted t train, lead and care for. It is simple question but carries a enormous responsibility in it execution.

"How is he?" His feelings, emotions, his health, fitness—physical, moral and mental, and hi family are part of him. How is h now? Today. Not last week or las month when you sat down wit him or quizzed him in passing "How is he?" is a thermostat typ of question, requiring constan checking on the part of the leade

And then there is the question of "Where is he?" Not just his physical presence, but his mental whereabouts, his outlook, as well as his education—military and civilian—proficiency. Where does he stand in his life goals and expectations? Has he placed himself in a "no win" box as many young people do? You are the leader; care for that soldier.

It is important to ask these three questions about each of your soldiers. Soldiers make up the fighting team, and it is the team that accomplishes the mission. If any soldier is not focused on the mission, has mentally drifted off, does not understand the job or is incapable of performing it, the whole team is placed at risk.

Caring is why I kicked soldiers out of the Army for taking drugs. Caring is why I called up parents; visited sick children; dug deep into my pocket; and was a hard ass when we trained.

The second trait is that of standards. Without standards, one has a mob. My thoughts are very simple and clear on this point. Standards must be stated, understood and enforced. No breaks. If a soldier, moreover a leader, walks by a substandard act and does not correct that act, that soldier, that leader, has lowered his standards. It is very important to understand that standards apply both to the individual and to others at the same time.

My first unit assignment was that of 1st Platoon, B Company, 10th Engineer Battalion, 3rd Infantry Division, in Bad Kissingen, Germany. My introduction was by way of the company commander, who wished me luck. The platoon had decided to quit. There had been an incident in which a squad APC had rolled over, killing three soldiers. The situation I was placed into was not really one of a platoon sitting down, although that is exactly what was going on. Rather, it was a case there the leadership had quit.

They failed to maintain standards. They failed to enforce safety and discipline. The leadership in that company was substandard and we now had mob rule on our hands. We changed it through the reintroduction of standards—clear, fair, and enforced at all levels, standards.

The other part of standards involves competition. Positive competition, the striving to be within that band of excellence, means competing against a standard and not one another. Standards, whether goal setting or hard competition, are the base line we all must operate from.

The third, and final, trait is that of readiness—total combat readiness brought about through the inculcation of all ten platoon leader tenets and the other two capstone traits. Readiness is what it is all about.

As I explain to soldiers, picture two gunfighters going towards each other in the main town called "Earth." When is the probability highest, the risk the greatest, that armed conflict will start between these two gunfighters? It is when the bad guy believes that he can beat the good guy. It is when, in the mind of the aggressor, it is felt that the other person, nation, Army, or soldiers you lead, do not look like they can cut it; that they are not ready. Not physically nor mentally capable of hanging in; not prepared, show no focus nor desire, or are simply not trained. The history of our world contains numerous examples of the "gunfighter theory."

What, then, provides for our nation's peace? It is the total readiness of our Army. History also tells us that peace comes through strong deterrence. Your mission will be to ensure that strength, commitment, steel-like moral fiber and exacting warrior excellence are present. Readiness, on a daily basis, gives us peace. Have no doubt that you and your soldiers are evaluated every day. It is no accident that there is a Soviet satellite stationed permanently over the National Training Center; that the Soviet Embassy in Washington has more directional antennas than any other building in that area, and that third-world countries read more about us than we read about ourselves and them combined.

Commitment to total readiness is needed every day, in everything we do. It must be a positive type of vigilance and concentration—a "can do" spirit. In 1978, tight-rope artist Karl Wallenda prepared for months to do his most difficult act. His whole life focused on walking the tight rope across two buildings in downtown San Juan, Puerto Rico. But his entire focus was on preventing his fall. Not on success.

Management books now talk about the "Wallenda Theory." You see, Karl Wallenda fell to his death because he failed to have a positive focus. Although he was great, his vision was negative. Readiness must include a positive warrior spirit which you instill in your soldiers through confidence and proficiency.

In closing, I urge you do to your best. When a platoon leader, be a platoon leader—not a little general, a staff whiny, an executive manager or a Rambo. Be a true leader of a platoon of America's finest professional peacemakers. Get totally involved with the platoon; focus on creating a team oneness without any superstars—they cost too much. Ingrain the three concepts—caring, standards, and readiness—into all you do. Focus on today; maintain that bold, spirited, battle vision.

There is a saying you should never forget as you start your calling: "Home is where the Army sends you." If you believe that, if you feel at home wherever you are with your soldiers, then you will be able to accomplish, with your troops, any mission—on time and on target.

The Army can be seen as a massive rock in front of your path. You have the choice of deciding what the rock will be to you. It is either a frustrating blockage, preventing you from getting to the other side, or it is a stepping stone, allowing you—and your soldiers—to move up. Move up to a higher plain of accomplishments, satisfaction and service to your nation.

Carry on, warrior!

Lieutenant Colonel Harback is attending the Army War College. He previously served as commander of the 14th Engineer Battalion (Corps), Fort Ord. He has served in various command and staff positions, including executive officer, Bayonet Combat Support Brigade, 7th Infantry Division (Light); deputy commander, 7th Engineer Brigade, VII Corps; S-3, 7th Engineer Brigade, and aide-de-camp to the commanding general, U.S. Army Western Command.

(Continued from page 31)

very closely at all levels of command. Almost all division and installation commanders have a monthly formal readiness meeting to review USRs. This is repeated in some form or other at every higher level of command. Even the Army chief of staff (CSA) chairs a formal monthly readiness review. At the CSA review, individual units down to detachment level that are experiencing chronic readiness difficulties are tracked, and steps are taken to correct the problem.

In conclusion, I want to recap some points made earlier. Every soldier has a stake in unit readiness. Combat readiness and survival depend on it. The system doesn't always help us with that readiness as much as we would like. We live in an imperfect world, and everyone has to expend more than the MELE to get the job done, get it right, and get it done on time. Don't be afraid to be the "squeaky wheel." Report accurately. To do otherwise is only hurting yourself and the Army.

My suggestions here are not "tricks" to make you look good on paper. They are real-world ways to improve your readiness and ability to "hit the ground running" if your unit is deployed to combat. Make the system work for you and your unit. Your mission success and battlefield survival will depend on it.

Colonel Dabbieri is chief of Combat Support Career Division, Enlisted Personnel Management Directorate, PERSCOM. Commissioned from Engineer OCS, he served in Vietnam and has commanded four companies. He also served as executive officer of the 19th Engineer Battalion, and commanded the 2nd Engineer Battalion in Korea. He is a graduate of Command and General Staff College and the National War College.

Engineer MOS
Consolidation

By Dr. Sue Mettlen

One of the stark realities facing today's Army planners is the need to create a smaller, less diverse, but still tactically capable force. One avenue for accomplishing this goal is reducing the number of engineer military occupational specialties (MOSs) by consolidating skill groups.

The most immediate result of this move toward MOS consolidation will be in the 12 career management field (CMF). Beginning in September 1992, the 12B ombat engineer and 12C combat bridge crewman will consolidate nto one MOS, the 12A sapper.

At skill level (SL) 1, this soldier will be known as an apprentice apper; at SL2, sapper; SL3, sapper supervisor, and SL4, senior apper. The 12F engineer tracked ehicle crewman will remain a eparate MOS from 12A at SLs 1, , and 3, and will be renamed en-ineer combat vehicle crewman. However, once 12F soldiers are romoted to sergeant first class nd awarded SL4, they will be-ome 12A senior sappers. This merges the entire CMF at SL4.

To support the consolidation, everal changes will occur in the Army education system. After eptember 1992, 12B and 12C ad-anced individual training (AIT) nd basic noncommissioned of-cer (BNCOC) courses will be ombined under 12A AIT and BNCOC. Separate AIT and BNCOC courses will be maintained for 12F soldiers, as will the current consolidated advanced noncommissioned officer course (ANCOC) for all 12CMF/SL4 soldiers.

> **The 12CMF consolidation... will go a long way toward yielding a leaner, less specialized, and more flexible engineer force.**

New products are being developed to support these dramatic changes in the combat engineer field. In mid-1992, the Engineer School will field soldier's manuals and trainer's guides for MOSs 12A and 12F. This summer, the school will also publish the task lists upon which the soldier's manuals are based. While some of the tasks in this list will be new, they will largely be an update and recombination of existing 12B, 12C, and 12F tasks. To assist soldiers in making the transition, there will be no self development test (SDT) for these MOSs in FY 93.

One of the most important factors leading to the 12CMF consolidation was the amount of overlap between 12B and 12C tasks. The 12C soldier was responsible for virtually every task of 12B personnel, plus those tasks specific to bridging operations.

The change will be demanding on soldiers. After September 1992, former 12Bs and 12Cs must be prepared to fulfill all missions assigned to the current 12B/C fields. The same is true for 12F/SL4s, who must function as 12A/SL4s after the implementation date.

These changes place great cross-training responsibilities on soldiers and leaders alike. Soldiers will have to invest a lot of individual time and effort in learning their new skills. Commanders and other leaders will have to ensure that the transition is implemented smoothly and without a loss of readiness.

The 12CMF consolidation, however, will go a long way toward yielding a leaner, less specialized, and more flexible engineer force. Such a force will be ready to meet the competing demands of ever-tightening budgets and the continuing need for combat readiness.

Dr. Mettlen is chief of the Engineer School's Individual Training Branch, Directorate of Training and Doctrine.

The CEV M970

Subcaliber Training Device

By Sergeant First Class Dennis L. Fulton

Getting "more bang for the buck" is on the minds of most military planners these days. But balancing the Army's budget, while maintaining soldier proficiency, is not always an easy task. The Engineer School, though, has come up with a way to save big money on combat engineer vehicle (CEV) gunnery training without losing critical soldier skills.

The school recently fielded the CEV subcaliber training device, also known as the M970. The device, which uses a relatively inexpensive 40 millimeter (mm) round, will be used to train engineers on proper loading, arming, aiming and firing procedures for the CEV's 165mm demolition gun.

Current CEV training uses the standard M123 high explosive plastic (HEP) round for gunnery qualification, and the M623 target practice (TP) round for prequalification gunnery practice. Both of these rounds are expensive, and must be limited to ranges which can accommodate such large munitions.

Cost Savings

Each 165mm TP round costs $450, while the 40mm round costs about $10. The annual ammunition requirement for the CEV in a combat engineer unit is 60 TP rounds. Using the 40mm round, each battalion can save more than $26,000 a year. In 1990, Training and Doctrine Command (TRADOC) used 247 TP rounds, costing more than $111,000. By using the M970, such training would have cost just under $2,500.

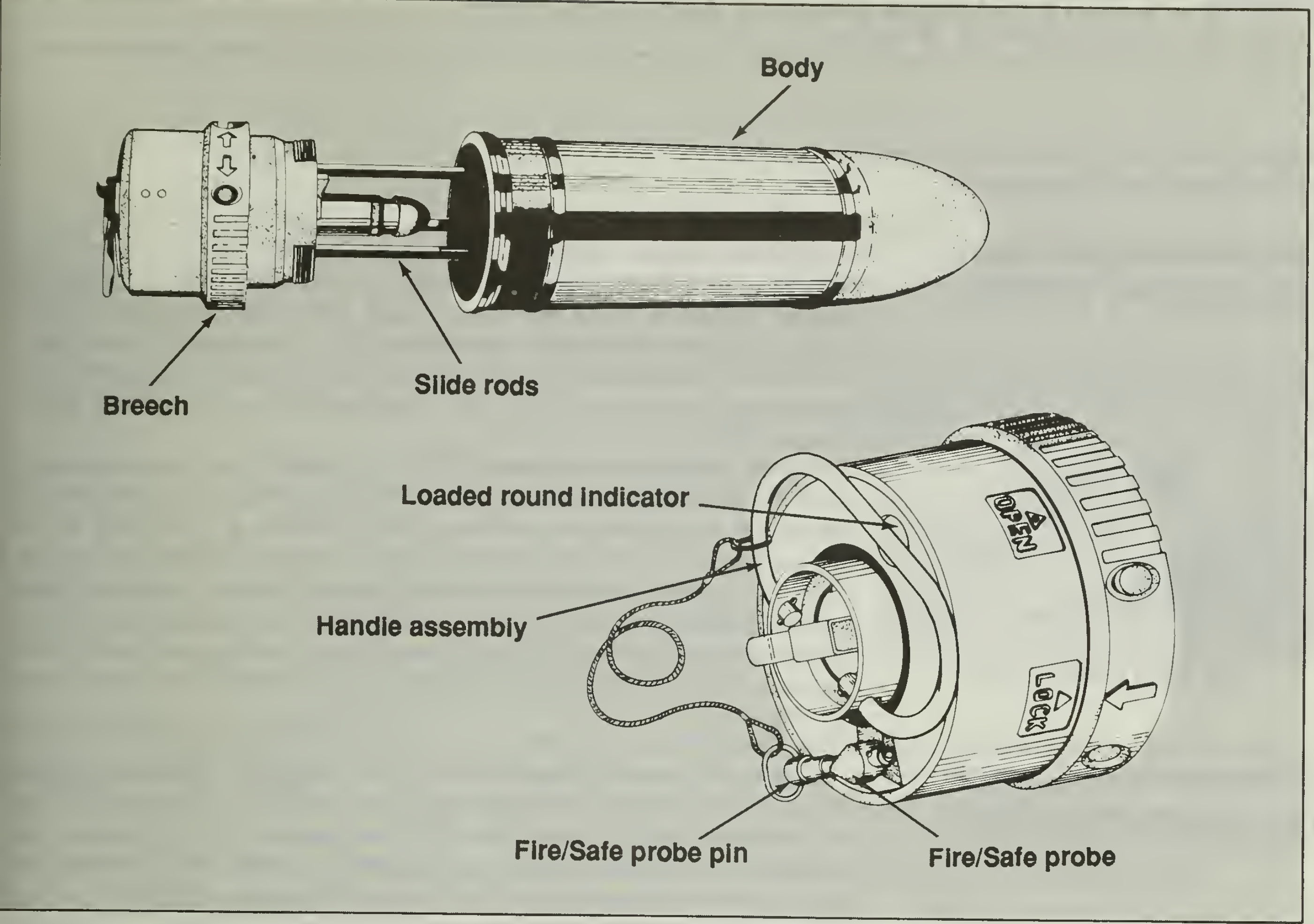
Fielding

The M970 was fielded at the Engineer School in December 1990. Units in Europe will begin receiving the device in July 1991, while Forces Command (FORSCOM) units will start getting it in August 1991. Engineer units in Korea will get the M970 in December 1991. Reserve and National Guard units will begin receiving the new device in July 1991.

Characteristics

The M970 approximates the size, shape and weight of actual M123 HEP and M623 TP rounds, and is reusable. Unlinked M918 40mm rounds are used as the projectile. The device, illustrated on page 61, consists of three main parts: the body, the breech, and the slide rod support system. The body portion contains the 40mm gun barrel. The breech separates from the body of the device to allow loading and unloading of the 40mm rounds. The breech also houses a solenoid that converts the CEV's electrical firing impulse into the mechanica energy needed to fire the 40mm round. The breech and body ar attached by three slide rods.

A fire/safe probe, a built-i safety feature, prevents accidenta firing of the M970. This prob protrudes from the closed breec



of the device, and must be depressed to permit firing of the 40mm round. As an additional safety feature, a visual indicator is ocated on the breech. A red visual signal indicates the presence of a chambered round. A white signal shows that the device is unloaded. To facilitate handling of the M970, a "D" handle is attached to the rear of the device, similar to an actual 165mm round.

Trajectory

To compensate for the slight trajectory difference between the 40mm and 165mm rounds, a range comparator card has been produced for use with the M970. The card allows the CEV commander to estimate range to his target, determine the corresponding comparator reading for 40mm ammunition, and announce the modified range to his gunner. The gunner then operates under the same conditions as if firing an actual 165mm round.

Tech Assistance

At least 30 days prior to receipt of the subcaliber device, field units will receive an exportable training packet from the Engineer School. The packet will contain a program of instruction (POI), and lesson plans on the operation and maintenance of the device.

The M970 requires engineers to follow the same procedures used to supply, prepare, load, and fire the 165mm ammunition. While not developed as a full replacement for the 165mm round (it will not be used for boresighting, for instance), the device provides excellent training at substantially lower cost. Simple, easy to use, and effective, the M970 will be a valuable addition to engineer training programs.

Sergeant First Class Fulton is a combat engineer training analyst for the Engineer School's New Equipment Systems Division. Previous assignments include company first sergeant, senior instructor, drill sergeant and platoon sergeant. He holds an associate degree from Columbia College, and is a graduate of the Advanced Noncommissioned Officers Course.

ENGINEER UPDATE

Autovon numbers are 676-XXXX, and commercial numbers are (314) 563-XXXX, unless otherwise noted.

Directorate of Training and Doctrine (DOTD)

CEV Mine Clearing Rake

Combat Engineer Vehicle (CEV) Mine Clearing Rake. A new mine-clearing rake used in the Saudi theater of operations made it easier for combat engineers to quickly clear a safe path wide enough for heavy tanks to move through enemy minefields. Put in operation in less than 4 months, the rake moves through sand and loose soil, bringing mines to the surface and moving them out of the vehicle's path. POC is David Carroll, -5020.

Soldier Training Publication (STP) 5-21II-MQS. The Branch-specific guide for lieutenants and captains, STP 5-21II-MQS, is scheduled for publication in March 1991. The manual provides an extensive list of books on a variety of technical and tactical subjects. Officers are strongly advised to read and study as many of these books as possible. When combined with other off-duty hours study, such as graduate courses or preparation for the Professional Engineer exam, this program can greatly enhance formal training and operational assignments. POC is CPT Paul Schroth, -7553.

Directorate of Combat Developments (DCD)

Special Projects Office (SPO). DCD recently added a Special Projects Office to help integrate new and emerging technologies within the engineer mission area. The SPO will provide a link between researchers and users to focus developmental efforts more directly on solving battlefield deficiencies. POC is Merrill Stevens, -7209.

Antipersonnel Obstacle Breaching System (APOBS). U.S. Marine Corps' breaching device program, APOBS, is continuing in development. APOBS is a man-pack explosive line change capable of destroying antipersonnel (AP) mines and wire obstacles for foot soldiers. The Army has accepted the Marine Corps' requirements document; upon completion, APOBS will be available to Army and Marine units for breaching operations. POC is Jim Smith, -7218.

Department of Combined Arms (DCA)

Critical Elements for Combined Arms Breaching. Combat Training Center results show that successful combined arms breaching rehearsals require five critical elements:

1. Key Player Involvement. Rehearsals must receive command emphasis. All subordinate leaders, company FISTs, battalion FSO, ADO, engineer leaders, S4/S1, battalion XO, battalion S3, and battalion commander are key players. The battalion commander and S3 must enforce attendance and personally lead rehearsals.

2. Rehearsal Progression. Unless a unit is highly trained, jumping straight into a full-scale rehearsal is impractical. Rehearsals progress from a rock drill to a full-scale rehearsal, as described below:

- *Rock drill.* Key players move their rock (unit) on a sand table, discussing actions during each movement. Key staff members describe significant actions as appropriate.
- *Leader walk-through.* Similar to the rock drill except the sand table is a large box. Leaders walk to positions in the box. The walk-through helps players appreciate adjacent units' actions and maneuver, and see how the operation is synchronized.

- *Leader-mounted walk-through.* The scale gets larger, with radio transmission added as the basis for communication and vehicle movement.

- *Full-scale rehearsal.* The entire force uses the scheme of maneuver on terrain similar to that for the mission and conducts required drills.

3. Standards and goals. All standards and goals must be set prior to rehearsal to ensure the objective and intent are understood. Subordinate units conduct their rehearsals prior to the task force rehearsal.

4. Breach rehearsal lane. A lane is constructed on terrain similar to that for the mission; it reflects the situational template. Separate lanes may be built to simulate in-stride/deliberate versus assault breach operations.

5. Resource allocation. As in any training event, units must allocate needed resources (time, space, materials, and personnel). POC is CPT Bob Wray, -5456.

Department of Military Engineering (DME)

Professional Engineer Application Deadline. The deadline for submitting applications for the 25 October 1991 Professional Engineer (PE) Exam is 27 June 1991. This deadine applies to most states. The Commonwealth of Virginia allows the PE exam to be taken in other locations. If you wish to receive a Virginia application, call (804) 367-8512.

Engineer Branch Safety Office (EBSO)

Army Motor Vehicle (AMV) Accidents. Ten fatalities resulting from AMV accidents have occurred in engineer units so far in FY 91, including five in Operation Desert Shield/Storm. Failure to perform to standards was the common denominator. Specific causes: Two fatalities occurred when drivers backed up vehicles without ground guides; two resulted from brake failure; in one case both the driver and assistant fell asleep; in at least one case soldiers failed to use seatbelts.

Soldiers must follow procedures before, during, and after operating AMVs. They must perform proper preventive checks to detect deficiencies, follow traffic rules, and drive defensively. Additional guidance is in AR 385-55. POC is Paul Rusinko, -5002.

Reserve Component (RC)

Engineer Officer Basic Course (EOBC-RC). Starting in FY 92, soldiers must complete the correspondence phase of EOBC-RC prior to attending the 8-week resident phase (OCS graduates). This is a change! POC is LTC Charles Doll, -7742.

1st Brigade

Engineers Adopt British Pipe Fascine System (PFS). A fascine system developed by Royal Engineers and used in Operation Desert Storm enabled U.S. Army engineers to maintain speed in attack, thus enhancing mobility operations. The PFS is a narrow gap-crossing system consisting of bundles of high-density polyethylene pipe fitted with launching and recovery chains. Procurement of the British system is being studied. POC is 1LT Cary Canter, AV 581-1581/8847 or (314) 596-1581/8847.

Officers Mess, Willets Point, New York

Beginning at Willets Point

Since the Army's first Engineer School was founded at Willets Point, New York, in 1867, the Army has trained engineer officers in practical engineering subjects. Many changes in curriculum and several changes in location have occurred during the school's 130-year history. This article describes the school from its founding through the move to Washington Barracks (now Fort McNair) in 1901. In some ways today's Engineer School mimics that earlier one: The curriculum is continually modernized to keep it relevant to Army doctrine, and the school recently changed location to improve training opportunities.

After the Civil War, the Battalion of Engineers was ordered to Willets Point to construct a new post and establish a depot for engineer equipment left in Virginia. In 1866 Brigadier General Andrew A. Humphreys, Chief of Engineers, determined that the battalion needed a large detail of officers to command and instruct engineer companies. He believed that all engineer officers should be exposed to troop command, and that young officers should extend their West Point training with theoretical and practical engineer subjects.

Humphreys envisioned a practical school of application, as opposed to strictly classroom work. He instructed Colonel Henry L. Abbot, the battalion commander, to establish a training program for new officers, non-commissioned officers, and the battalion's enlisted men.

Instruction began in the summer of 1867, with students working on sextants and the construction of model "fronts" of forts, at a scale of 1 to 12. During the first 18 years growth was piecemeal. Training in meteorological observations, reconnaissance, and surveys were added in 1868. Meteorological observations included hourly listings of barometric pressure, temperature, and humidity. Students performed reconnaissances and surveys to develop information for military maps. Later, each officer carefully surveyed and prepared contours for one square mile of territory using ordinary surveying equipment.

A field astronomical laboratory added in 1869 enabled officers to use an astronomical transit, zenith telescope, a telescope for occultations, sextants, and chronometers. Weather permitting, officers in the battalion devoted the hours of sunset to midnight to regular observations. Results of these observation were published annually in Battalion Orders.

A modern observatory replaced the old one in 1879. Using updated equipment, students learned how to determine latitude and longitude, and registered unusual astronomical events such as sun spots. As a result of the school's latitude records, scientists discovered a new oscillating motion of the earth on its axis.

Study also included hypothetical enemy invasions. In the summer of 1872, all commissioned officers prepared a detailed line of field works that stretched from Willets Point to Jamaica Bay. The field works were to protect Brooklyn against a hypothetical invasion of 100,000 men along the east end of Long Island. Forces available for defense consisted of 30,000 militia infantry, three companies of engineers, a full regiment of artillery, plus field artillery.

Practical instruction in submarine mining began in 1872, when responsibility for seacoast defense was assigned to the Corps of Engineers. By 1874, the Corps had acquired 600 miles of torpedo cable and 300 mines. To accommodate this training, the school added a Torpedo Laboratory for officers and a building for the instruction of enlisted men. Students worked with torpedoes that were steered by electricity from shore—electrical transmission of power was new technology at that time.

The name "School of Application" was officially applied in 1875. The school continued to expand, and in 1884 Secretary of War Robert Todd Lincoln increased the enlisted men in the battalion to 400. The next year the school reorganized into five

By Dr. Barry Fowle

departments: Military Engineering, Submarine Mining, Civil Engineering, Practical Astronomy, and Military Photography. The academic staff included the battalion's field officers, senior staff officers, and company captains. As part of their training, officer students were assigned to instruct enlisted students in military and engineering subjects.

During this period, officer students arrived at the battalion from West Point in the October following graduation. The first two months were spent becoming familiar with routine military duties. Then they began a program lasting two and one-half years, with the school year divided into winter and summer courses.

Starting in 1880, the school conducted a 6-month course in submarine mining for engineers plus two artillery officers. Ten years later, infantry and cavalry officers, in addition to artillery officers, began attending a new 9-month submarine mining course for non-engineer officers.

When the War Department reorganized the school again in 1898, they officially designated it the United States Engineer School. Its objective was to increase the professional qualifications of officers assigned to the Corps of Engineers. Under this reorganization, the program was shortened to two years and the departments of instruction were reduced to three: Military Engineering, Electrical Engineering, and Civil Engineering.

The program of instruction for Military Engineering included reconnaissances of routes and positions; maps, plans, and military photography; explosives; military bridges; campaigns; and land and coast defenses. Electrical engineering included the application of electricity to seacoast and land defenses, power transmission, and torpedo instruction. Civil engineering included surveying and practical astronomy, preliminary examinations of navigable waterways, river and harbor improvements, detailed studies of building materials and methods of construction, and river and harbor works. Lectures by Army and Navy officers and civilians, and visits to military and manufacturing establishments supplemented the course work.

The school suspended operations from April to November 1898 due to our war with Spain. This was the only time the school closed except for the period 1917-1919, in World War I.

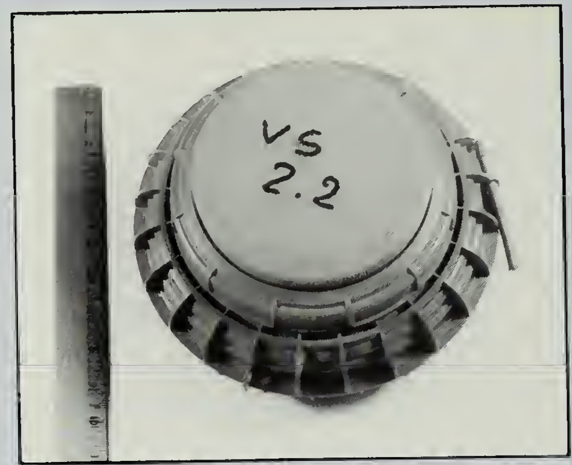
When the school moved to Washington Barracks (now Fort McNair) in 1901, the name changed again—this time to the Engineer School of Application, United States Army. Instruction methods used in the two-year program included lectures; readings, with the students taking notes that were graded; and student theses and projects. Instructors examined the students at the end of each course and rated them "proficient with honor," "proficient," or "deficient."

One part of the school did not move to Washington Barracks. By an act of Congress, the care and operation of torpedo defense reverted to the artillery, and all torpedo materiel transferred to them in 1902.

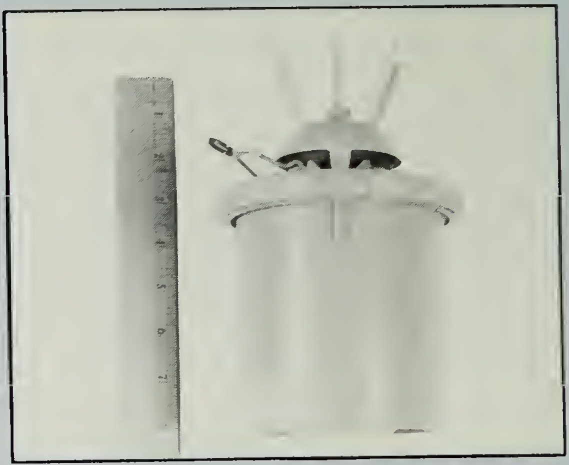
Throughout its history, the United States Engineer School has expanded and reorganized to maintain a highly trained force of Army engineers. The Engineer School of the 1870s and 80s proved to be a stepping stone for the establishment of a modern school for training engineers through the 1890s and into the 20th century. Today, at the threshold of the 21st century, we continue to build on this tradition.

Dr. Barry Fowle is an historian, Office of History, U.S. Army Corps of Engineers, Fort Belvoir, VA. He earned a Ph.D in history from the University of Maryland.

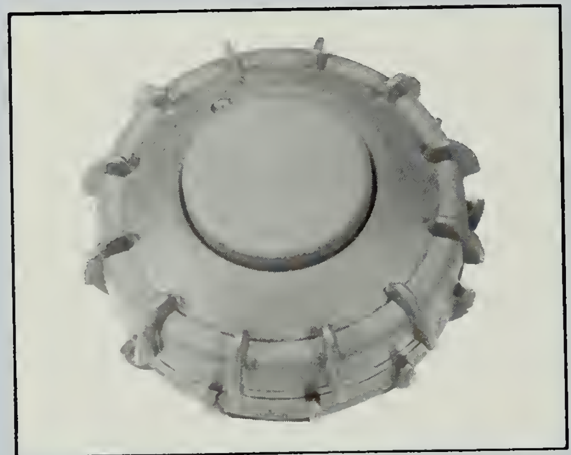
Torpedo Laboratory, Willets Point, New York.



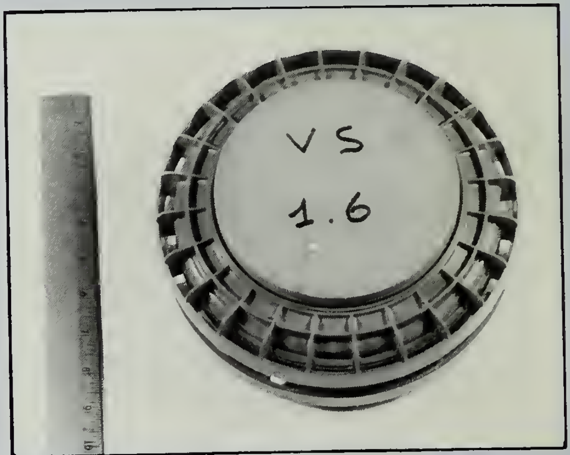
VS - 2.2, Italian conventional anti-tank (AT) mine, blast-resistant, pressure activated.
Weight: 7.7 lbs. Diameter: 9.4 in.



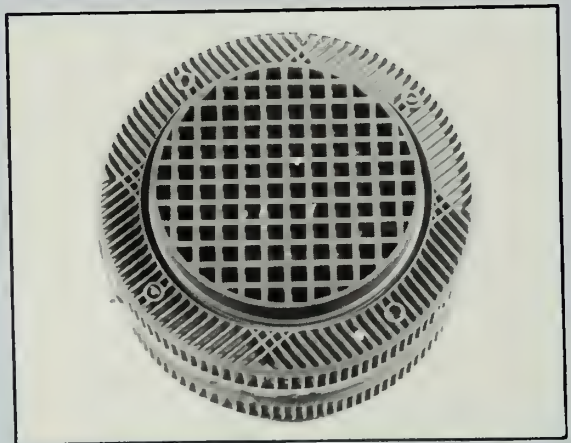
VALMARA 69, Italian conventional anti-personnel (AP) mine, trip wire or pressure initated.
Weight: 7.3 lbs. Height: 8.1 in.



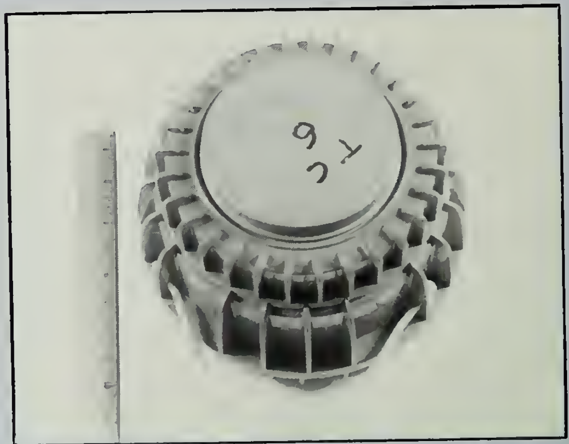
VS - 50 or TS - 50, Italian scatterable AP mine, blast-resistant, pressure activated.
Weight: 6.6 oz. Diameter: 3.5 in.



VS - 1.6, Italian scatterable AT mine, blast-resistant, pressure activated.
Weight: 6.6 lbs. Diameter: 8.7 in.



TC/2.4, Italian scatterable AT mine, blast-resistant, pressure activated.
Weight: 7.3 lbs. Diameter: 8.0 in.



TC - 6, Italian conventional AT mine, blast-resistant, pressure activated.
Weight: 21.2 lbs Diameter: 10.6 in.

Taken from *Mine Recognition and Warfare Handbook,* November 1990

PIN: 054569-000

8.205
v.21#3

ENGINEERING

Engineer

PROFESSIONAL BULLETIN FOR ARMY ENGINEERS
Headquarters, Department of the Army

July 1991

Engineers and the Environment

PB 5-91-3

Approved for public release; distribution is unlimited

Supporting CINCs in Peacetime

The U.S. Army may be a key player in a bold, new program aimed at developing free, stable, and prosperous nations throughout the Western Hemisphere. This conceptual program will encompass the Department of Defense (DOD) and use existing flag units (general officer units from Army, Navy, and Air Force), and agencies affiliated within their functional responsibilities. These units will assist commanders in chief (CINC) during peacetime to support other government agencies, particularly the State Department and drug law enforcement agencies.

The program has merit. Looking into the future need for U.S. armed forces, we see it is logical and practical for military organizations to support CINCs in nation assistance. While the Army and other DOD services now participate in nation assistance activities, many projects are accomplished independently, with little or no coordinated planning. Under the new, joint service concept, planning for all agencies will be coordinated, with the recipient country's U.S. ambassador assuming overall responsibility.

Engineer Roles

This article describes the part engineers will play, using Central and South America as a concept model. I will describe engineer unit/agency affiliation and tailoring for campaign planning, crisis response, and special studies in consonance with proposals being developed for nation assistance policies, doctrine, and training. With some modification, the program can be applied to medical, civil military cooperation (CIMIC), and logistical units.

Let's define the major activities.

Campaign planning includes the preparation of long-range engineer, country, and campaign plans, activity development and evaluation, and development of host nation civilian and military institutions.

Planning support to the U.S. counternarcotics campaign will link nation assistance activities to counternarcotics operations. It will anticipate counternarcotics facility requirements as narco-trafficking routes migrate, and promote counternarcotics and nation assistance activities that support U.S. ambassadors' country plans.

Engineers will ensure that counternarcotics considerations are built into construction projects. For example, an airfield built by the Army as part of a nation assistance project will be located where it can later serve commercial traffic. Or, we will ensure that Army-built schools are complete packages, equipped with books and teachers.

Crisis response augmentation includes assistance with natural disasters, noncombat and evacuation operations, and operations short of war.

In a crisis, U.S. military forces will be augmented from the same organizations that provided the planning and host nation support. Functions performed by U.S. military will include damage surveys and assessments, emergency operations, contracting, and natural disaster and hazard mitigation.

The U.S. will look for short-notice, brief deployments of selected personnel to serve on joint task forces and to augment command staffs. Primary resources for these missions will be U.S. Army Corps of Engineers (USACE) South Atlantic Division, U.S. Air Force (USAF) Engineering and Services Center, and Navy Commander Construction Battalions Atlantic (COMCBLANT) and Naval Facilities Engineering Command (NAVFAC) in the Southern Command's (SOUTHCOM) administrative offices.

Special studies include host nation infrastructure assessments, installation plans, and surveys of U.S. and host nation owned facilities.

Army personnel must be teachers as well as doers. We must ensure that host nation personnel participate to the maximum extent practical in all construction-related activities. Future host nation institution development must include opportunities to advance the capabilities of their military and civilian organizations. Seminars and short courses, exchange programs, and mobile training teams can provide training. We will tap engineer resources throughout DOD, including USACE laboratories, the Army Engineer School, Naval Facilities Engineering Command, and Air Force Engineering and Services Center.

Organization Requirements

In Central and South America, SOUTHCOM will take the lead in activity evaluation, selection, and execution. Support will be provided by the 412th Engineer Command, selected Army National Guard and Reserve engineer brigades, USACE South Atlantic Division, Navy COMCBLANT, NAVFAC, and Reserve Navy Facilities Command, and the USAF Engineering and Services Center. Key players and thei functions are:

The 412th Engineer Comman will provide planning direction an continuity, and theater-level planning and support. It will maintain

(Continued on page 31)

By Major General Michael A. Schulz, Jr.

Engineer

July 1991

Volume 21 PB 5-91-3

DEPOSITORY
AUG 12 1991
UNIVERSITY OF ILLINOIS

UNITED STATES ARMY ENGINEER CENTER AND FORT LEONARD WOOD

COMMANDER/COMMANDANT
Major General Daniel R. Schroeder

MANAGING EDITOR
Catherine Eubanks

FEATURES EDITOR
Phillip R. Howell, Jr.

GRAPHIC DESIGNER
Jennifer C. Bolyard

By Order of the Secretary of the Army:

CARL E. VUONO
General, United States Army
Chief of Staff

Official:

PATRICIA P. HICKERSON
Brigadier General, United States Army
The Adjutant General

Cover photo: *Engineer monitors air at drilling construction site (photo by J.M.S. Co., Inc.).*

FEATURES

4 **Engineers and Environmental Protection**
by Lieutenant Colonel Christopher P. Werle

9 **Training and Fighting with the Saudis**
by Major John R. Jones, Captain Everett McDaniel and Captain Stephen R. Zeltner

14 **Tackling Hazardous Waste at Fort Bragg**
by Stephen J. Mackmull and George D. Sample

18 **Area Damage Control: The Forgotten Mission**
by Major Edward M. McClure

24 **Underground Storage Tanks: The Silent Menace**
by Scott Murrell

28 **Operation Cross My Heart**
by Major Thomas J. Kelly

37 **Terra Geode: The Army in Space**
by Captain John Karpiscak III

49 **A District's Environmental Learning Curve**
by Colonel Wilbur H. Boutin, Jr.

53 **Commanders and the 15-6 Investigation**
by Captain Andy K. Hughes

DEPARTMENTS

Inside Front Cover: **Personal Viewpoint**

2 **Clear the Way**
3 **Bridge the Gap**
23 **Engineer Safety**
32 **Engineer Problem**
42 **Lessons Learned**
44 **Book Review**
45 **Engineer Solution**
56 **Engineer Update**
59 **Past in Review**

ENGINEER (ISSN 0046-19890) is prepared quarterly by the U.S. Army Engineer School, ATTN: ATSE-TDM-PB, Fort Leonard Wood, MO 65473-6650. Second Class postage is paid at Fort Leonard Wood, MO, and additional mailing offices.

POSTMASTER; Send address changes to ENGINEER, the Professional Bulletin for Army Engineers, ATTN: ATSE-TDM-PB, Fort Leonard Wood, MO 65473-6650.

CORRESPONDENCE, letters to the editor, manuscripts, photographs, official unit requests to receive copies, and unit address changes should be sent to ENGINEER, at the preceding address. Telephone: (314) 563-7762, AV 676-7762.

DISCLAIMER: ENGINEER presents professional information designed to keep Army engineers informed of current and emerging developments within their areas of expertise. Views expressed are those of the author and do not necessarily reflect official Army or TRADOC positions, nor does the content change or supersede information in other official Army publications. ENGINEER reserves the right to edit material.

CONTENT is not copyrighted. Material may be reprinted if credit is given to ENGINEER and the author.

OFFICIAL DISTRIBUTION is targeted to all engineer and engineer-related units.

PERSONAL SUBSCRIPTIONS are available by contacting the Superintendent of Documents, ATTN: Chief, Mail List Branch, Stop SSOM, Washington, DC 20402. Address changes for personal subscriptions should also be sent to the Superintendent of Documents.

CLEAR THE WAY

By Major Daniel R. Schroeder,
Commandant, U.S. Army Engineer School

When I assumed my duties as 47th Commandant of the U.S. Army Engineer School, I said that it was an exciting time to be an engineer soldier. I was honored to accept the position and the challenges that went with it. In retrospect, I may have underestimated just how exciting things would be. In the past three years we have witnessed sweeping changes in the world order. These changes provided opportunities and presented challenges that will carry our engineer community well into the future.

The move to Fort Leonard Wood and establishment of the Engineer Center as "home" for our Regiment has been accomplished. We now provide great training at one location for all engineer soldiers, from private to colonel. We will continue to exploit our capabilities in this area.

Engineer combat developments experienced unprecedented opportunities as the Army officially adopted the Engineer Restructure Initiative (ERI). Years of hard work were rewarded when our forces organized under ERI during Desert Storm and provided superb support to the combined arms team. The M9 ACE, which was fielded to many units during Desert Shield, proved itself and became a valued addition to our combat engineer capabilities. The successes of the CEV mine rake, countermine equipment, and other minefield breaching equipment are tributes to the dedicated efforts of combat developers.

The understanding and application of topographical engineering operations in support of combat operations increased greatly in the past three years. The concept of automated graphic terrain visualization support at the tactical level was validated time and again as our forces deployed to fight at locations around the world. The Engineer School is on the cutting edge of this evolving technology and leads the way in developing it for use in AirLand Operations.

Our engineer doctrine is evolving from AirLand Battle, with a primary focus on a strong forward defense in NATO, to AirLand Operations, which focuses on power projection with global responsibilities across the operational continuum. During this evolution, engineer soldiers were employed in roles ranging from domestic support (counterdrug), disaster relief, and nation assistance, to low-intensity conflict and mid- to high-intensity coalition warfare. Sound, flexible doctrine has never been more important than it is today, as we prepare to meet future challenges.

The dynamics of shaping a smaller Army while improving the professional development of officers and noncommissioned officers (NCO) has caused us to scrutinize accession criteria, training and operational assignment opportunities, and distribution of engineers. This effort coincides with the fielding of ERI. Rather than limiting opportunities, the new engineer force has a proportionally greater number of command and leadership positions for officers and NCOs. Quality performance in the full range of leader and staff assignments will continue to determine the successful progression of soldiers. And for those who demonstrate excellence, the opportunities for school, promotion, and special assignments will be available at nearly the same rates as today.

The competitive edge of the engineer force has never been better. The quality of new enlisted soldiers and junior officers has improved with tougher standards for enlistment and commissioning. The accomplishments in southwest Asia reflect these new standards in soldier development.

The Army's top priority now is to shape the force for the future as its size decreases by as much as 25 percent, while maintaining a structure capable of timely response to every contingency. Engineers must maintain the ability to meet these challenges. We must attract and retain high quality personnel; maintain forward-looking warfighting doctrine; continue tough, realistic training; sustain modernization; and develop competent, confident leaders.

The foundations for this work are sound. Thanks to the unselfish, dedicated efforts of many people, military, civilian, and contractor, your engineer force is a respected member of the combined arms team. Maneuver commanders are our strongest advocates for the improvements required to bring our capabilities up-to-date. The heritage of this great school and the engineer force is the result of the work of our predecessors, to whom we owe our continued dedicated efforts. To them, and those who still labor in our vineyard, I give my respect and appreciation for your loyal support during my tenure.

Many of you know my successor, General Dan Christman, who is a distinguished soldier. I am sure he will continue our tradition of solid training and responsive support to the field. General Christman is uniquely well qualified to be the engineer proponent as we embark into what I believe will be a watershed

BRIDGE THE GAP

By Command Sergeant Major W. E. Woodall
U.S. Army Engineer School

With all the changes taking place within the Army and throughout the world, it is important that we noncommissioned officers (NCO) retain a clear picture of our mission. We must continue to meet today's challenges, as we have in the past, with professionalism and a "we can do it" attitude. Whatever the future brings, we must remain flexible and eager to meet the challenge.

We noncommissioned officers are the best trained and most highly qualified group of soldiers the Army has ever produced. The performance of engineer NCOs in support of the Gulf War effort was outstanding, and reflects our dedication and pride in supporting the Commander in Chief.

As I reflect on the qualities that make an outstanding NCO, the terms "technical competence" and "tactical proficiency" come to mind. These terms best describe the attributes NCOs need to succeed in a changing environment. I will take this opportunity to stress the importance of these attributes, and to describe what NCOs must do to prepare for an ever-changing future.

Technical competence, as related to our ranks, is a combination of schooling, job assignments, and self-development. It includes both formal and informal civilian and military education that develops specific job-related skills and leadership abilities.

To remain competitive in the NCO system, you must continually seek jobs that require training at the next level higher than your current pay grade. It is not enough to wait for training to be scheduled. Take the initiative by enrolling in service school correspondence courses or courses in the civilian education system.

Technical competence is more than being able to perform your tasks. It is the building block of confidence, respect, and trust your soldiers will have in you as a leader. Because it is essential for soldiers to have confidence in their leaders, you must set an example by taking advantage of every training opportunity. You must encourage your soldiers to identify their shortcomings and then eliminate those shortcomings through remedial or advanced training.

Some soldiers fail to graduate from basic or advanced courses because they lack the reading, comprehension, or mathematical skills needed to understand the instruction. If you see a soldier having difficulty with basic skills, encourage him or her to enroll in remedial courses that will strengthen them. To develop future leaders in light of current decreasing resources challenges us to take advantage of every developmental opportunity.

Tactical proficiency refers to knowledge of tasks critical to our current warfighting doctrine. These are the skills NCOs need to survive on the battlefield. Tactical proficiency is essential to meeting our mission, and it requires tough, realistic training at home stations and at combat training centers.

We must ensure that every NCO is prepared to deploy anywhere, at any time, to fulfill our national defense needs. To achieve this proficiency requires that we take the initiative to train ourselves in critical tasks and encourage others to do the same. We must take the initiative for our self-development as opportunities occur to prepare for battlefield contingencies. Training at each of the schools in the NCO education system is another building block in preparing NCOs for success in their military mission.

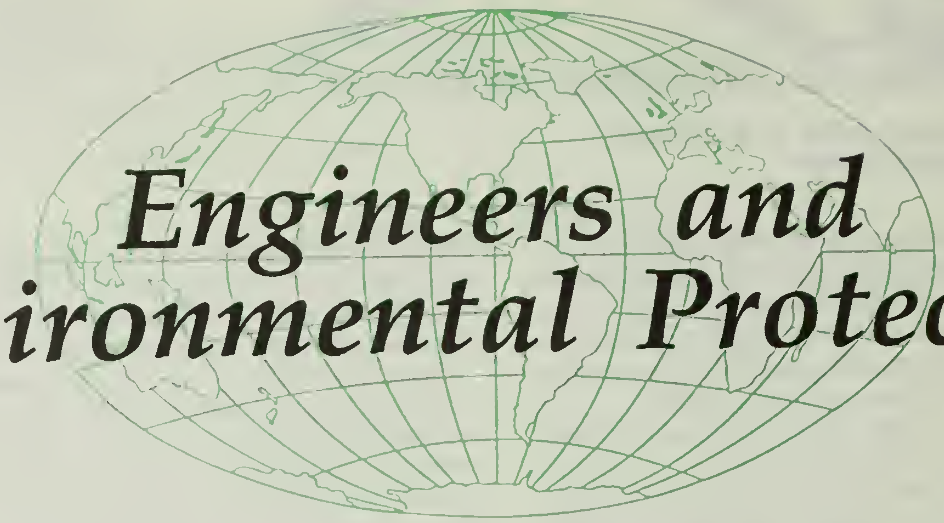
Leader development is our business. I ask senior NCOs to provide their soldiers opportunities to be successful. Give them all the responsibilities they can handle, and hold them responsible for their actions. Above all, do not compromise the Army's professional standards. If we do these things, NCOs will be prepared to meet, with confidence, any change the future brings.

CSM Woodall assumed duties as TRADOC Command Sergeant Major in May 1991.

(Clear the Way, continued)

period in our history. Give him the same loyal support you have demonstrated to me and my predecessors, and I am confident engineers will continue to Clear the Way.

One parting comment: Do not forget the nature of your business—it is warfighting! That is, to support combined arms operations across the continuum. Keep the sapper spirit alive and there is no challenge we cannot overcome. Essayons!



Engineers and Environmental Protection

By Lieutenant Colonel Christopher P. Werle

Over the last 20 years, the environmental conscience of this nation has experienced an unprecedented awakening. As members of the global society, we have moved our environmental concerns to the forefront. We have an increased sensitivity to diminishing resources and the potentially disastrous impact of continued indifference and neglect. As a result, legislators have enacted statutory requirements to control potentially harmful industrial activities in the public and private sectors. Toward that end, the Congress, enforcement agencies, and the public have clearly stated that federal facilities should be models of compliance to these guidelines.

Technicians from the Army Corps of Engineers check decontaminated pipe used for a test well on a hazardous waste site (U.S. Army photo).

As one of the largest federal real estate holders (over 2,000 installations on more than 24 million acres of land), the Army is keenly aware of its responsibilities in the areas of environmental protection and enhancement. In consonance with its defense mission, the Army has established an environmental management policy that will ensure the long-term protection of the land and resources entrusted to its care.

Issued jointly by the Secretary of the Army and Chief of Staff, this policy charges the Army with being the environmental leader within DOD. It mandates that taking care of the environment is a necessary cost of business that must be fully integrated into all aspects of mission accomplishment.

A key concept inherent in this policy is that our actions must be "environmentally sustainable." That is, we must enable mission accomplishment without compromising the environmental integrity of future generations.

To ensure proper focus and continued development of this program, the Army has established a comprehensive, forward-looking military environmental program. Falling under the purview of the Chief of Engineers, day-to-day management is provided by the Office of the Assistant Chief of Engineers, the Army Environmental Office, and the Army Corps of Engineers' Directorate of Military Programs. Funded for FY91 at more than $1.2 billion, it addresses the major functional areas of compliance, restoration, prevention, and stewardship. It also provides for incorporating military programs, civil works, and support for other agencies.

Environmental Compliance

Army installations and facilities are required to comply fully with all applicable federal, state and local environmental statutes and regulations. Because there are more than 50 major federal environmental statutes on the books, with more being introduced every year, total compliance is a challenging and sometimes elusive goal.

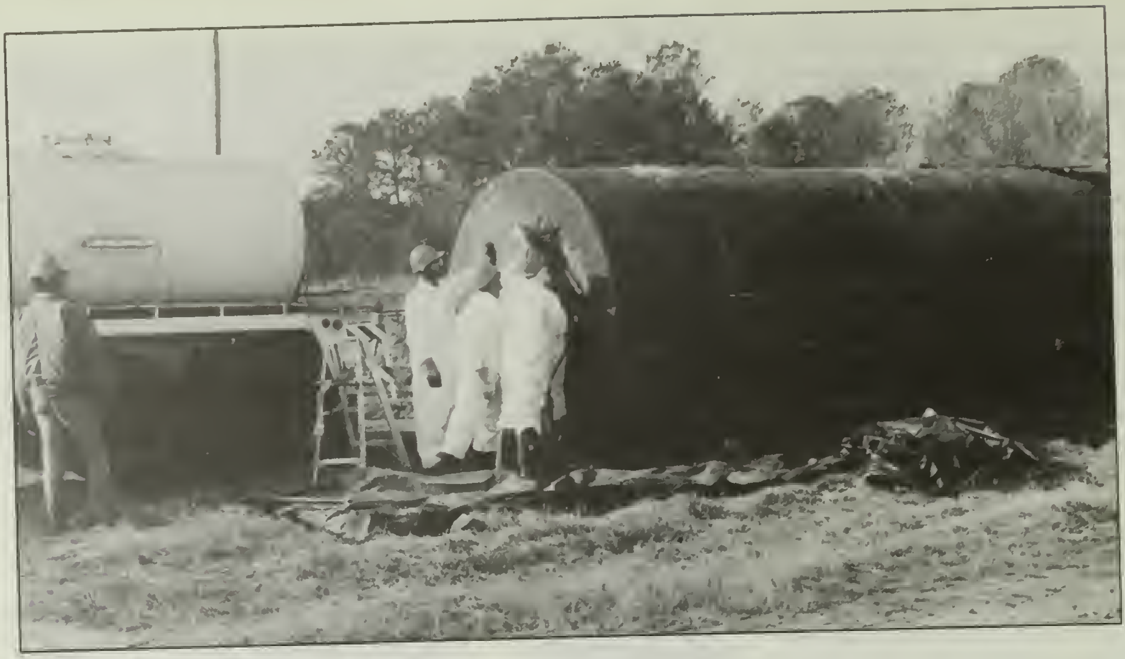
To help meet its responsibilities, the Army established the Environmental Compliance Achievement Program (ECAP), which is funded for FY91 at $364 million. ECAP is an umbrella program which integrates the five basic steps needed to achieve and maintain environmental compliance: training, planning and programming, resourcing, assessing, and correcting deficiencies. The program addresses all environmental areas (except restoration), and ensures that the Army will:

- Program adequate funding and resources.
- Require and provide environmental training.
- Develop reports on compliance status and improvement efforts.
- Provide technical assistance to installations for implementing the program.
- Reduce the production of hazardous waste.
- Monitor expenditures on the program.
- Track environmental compliance issues.
- Recognize outstanding environmental efforts by installations and employees through an awards program.

The ECAP concept incorporates provisions of the National Environmental Policy Act (NEPA) of 1969. NEPA requires that all federal agencies consider the environmental impact of their actions, and take positive steps to eliminate or mitigate operations that have an adverse environmental impact.

Preparing a monitoring well for insertion of tubing (U.S. Army photo).

A key element of ECAP is the newly established Environmental Compliance Assessment System (ECAS). Essentially an expanded auditing program, ECAS determines how well Army installations are complying with applicable federal, state, local and host nation environmental regulations. Under this program, environmental compliance assessments are conducted for installations every four years by an independent agency. Internal, or self audits, are conducted at the mid-point of every four-year cycle. Such assessments help installations identify deficiencies, develop corrective action plans, and manage their program resources in order to achieve compliance. While auditing has always been required, it was not always effectively implemented because of budget constraints. The ECAS program will formally begin in FY92, and will receive about $25 million in funding.



An underground storage tank is inspected after removal from a contaminated site (U.S. Army photo).

Environmental Restoration

The magnitude of the hazardous waste problem in this country is so great that it almost defies comprehension. In addition to what's buried in thousands of disposal sites nationwide, the Environmental Protection Agency (EPA) estimates that our country generates 700,000 tons of hazardous waste every day—or more than 250 million tons a year. Of that figure, the Army generates some 100,000 tons a year, chiefly through its industrial operations within the Army Materiel Command.

Recognizing that federal laws were needed to address the potential dangers of abandoned hazardous waste sites, Congress passed the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). As the first major piece of legislation to address the problem on a national level, CERCLA has these key objectives:

- To hold responsible parties liable, where possible, for the cost of cleaning up hazardous waste sites.
- To establish a $1.6 billion Hazardous Waste Trust Fund (Superfund) to enable site cleanup when responsible parties cannot be found, and to respond to emergencies involving hazardous materials.
- To foster improved scientific and technological capabilities to deal with hazardous waste management, treatment, and disposal.

The Superfund Amendments and Reauthorization Act (SARA) of 1986 clarified that "each department, agency, and instrumentality of the United States..." was required to comply procedurally and substantively with the statute to the same extent as private companies.

While this was clearly a landmark piece of legislation, it was upstaged by Army efforts to deal with hazardous waste sites. In 1974, a full six years before the Superfund law was enacted, the Army initiated the Installation Restoration Program (IRP), which is now part of the larger Defense Environmental Restoration Program (DERP). Funded for FY91 at $287 million, the IRP is designed to identify and remedy contamination from hazardous substances and wastes at all Army installations. Army policy under the IRP is to clean up sites on a "worst first" basis. To date, 17,482 sites on 1,855 installations have been surveyed to determine what needs to be done. While only about 40 percent of these installations will ultimately require cleanup, the large number of sites surveyed is testimony to the thoroughness of the IRP program. By the end of FY90, the Army had completed cleanup on 130 sites.

In some cases, site contamination has been extensive enough to warrant placement on the National Priorities List (NPL) by the Environmental Protection Agency. Currently, the Army has 36 NPL sites located at 32 installations. Federal Facility Agreements (FFA) have been negotiated at 22 of these sites, and we're making good progress on the remainder. FFAs serve as regulatory "blueprints" for facility cleanup. They also provide for state and EPA oversight of the cleanup process, and, in most cases, reimbursement for states' cleanup costs.

In addition to managing its own program, the

Army serves as executive agent for DOD in managing the Formerly Used Defense Sites (FUDS) program. Under FUDS, some 7,000 additional sites are being surveyed for possible cleanup operations. Surveys have been completed on 2,400 sites, with 1,700 found to need no further action. Of the remainder, 85 have been cleaned up. FY91 resources dedicated to the FUDS program total $87 million.

It's important to note that the majority of environmental contamination problems on today's Army installations originated many years ago. At that time, the Army was in full compliance with applicable environmental laws. Unfortunately, we now know that the old laws were inadequate.

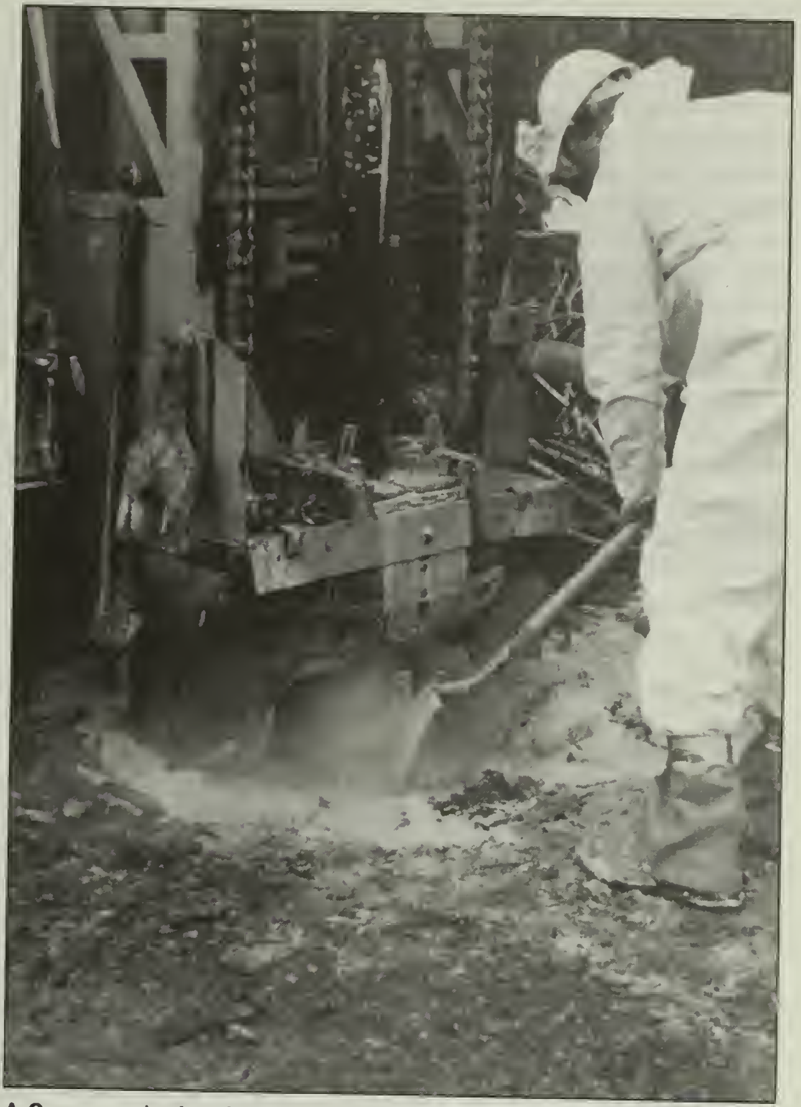
While work done under the IRP has been an expensive and sometimes necessarily slow process, we're confident the Army is doing the right thing to repair the damage. Our goal is to have cleaned up—or at least initiated cleanup on—all contaminated sites by the turn of the century.

Prevention

Most environmental legislation over the past 20 years has been geared toward controlling pollution. That is, pollutants are permitted to enter the environment in reduced concentrations, or hazardous wastes are placed in landfills designed to eliminate or reduce their detrimental effects. While this philosophy has done much to limit the uncontrolled spread of contamination, it has done little to actually preclude the introduction of waste materials into the environment.

The Army believes that prevention must be the focus of our efforts over the next 20 years. In other words, if we limit waste generation, our disposal and containment problems are similarly reduced. To do that, we have initiated several programs aimed at reducing the amount of hazardous materials used in daily operations.

One of our key initiatives is the Hazardous Waste Minimization (HAZMIN) program. Instituted in 1984, it established the Army's goal of reducing hazardous waste generation 50 percent by the end of 1992. Methods being employed under this program include recycling, using non-hazardous materials in place of hazardous ones, modifying specifications for system acquisition, developing more stringent procurement policies, improving material tracking, and improving our knowledge and use of new waste reduction technologies.



A Corps geologist checks contaminated soil brought to the surface by a drilling rig (U.S. Army photo).

In addition, the Army recently completed development of a 5-year Integrated Hazardous Material/Hazardous Waste Management Plan (HM/HW). Under this plan, we have identified 13 major areas where additional emphasis is needed to streamline and improve the overall effectiveness of our efforts at controlling waste materials. Other ongoing and planned activities include precious metal recovery, recycling used oil, and the Used Solvent Elimination (USE) program.

Stewardship

In the traditional sense, stewardship relates to proper land management, including the preservation of cultural, natural and archaeological resources. Programs like Integrated Training Area Management (ITAM) help us identify environmentally sensitive areas on each installation. This helps us make smart environmental decisions as we plan and develop training ranges, maneuver areas, and other capital improvements.

But from a larger perspective, being good stewards means that we also comply with environmental laws and regulations as a normal way of doing business. It also requires that we clean up our past mistakes, take positive steps to prevent recurrences, and pursue new ways to reduce the amount of pollution we generate. It means that we need to be more sensitive to the potential impact of our operations on our country.

To further this stewardship philosophy, the Army is working hard to improve communications with other federal agencies as well as the general public. It's hoped that mutual understanding of environmental problems and programs will foster greater involvement and commitment among all parties.

Program Initiatives

The Army is committed to the long-term development and continued effectiveness of environmental programs. To support that dedication, we have completed or initiated these major programs:

- Revised AR 200-1, *Environmental Protection and Enhancement.*
- Published Commander's Guide to Environmental Management.
- Established new tracking procedures to provide better management of environmental compliance funds.
- Established an environmental "hotline."
- Established an Army Automated Environmental Management Information System (AAEMIS) to provide needed management tools.
- Established an Army Environmental Response and Information Center (ERIC).
- Established a Senior Executive Environmental Council to foster a proactive stance in anticipating future requirements and implementing needed policies.
- Developing an Army Environmental Training Master Plan to promote environmental awareness in the Army community.
- Developing an environmental career management field staffing guide.
- Developing an increasingly effective support structure to provide environmental support to installations.

Strategy for the Future

The Army is moving toward the next century with a sound environmental program. But we recognize that there are many challenges still before us. Our key areas of focus will be prevention, developing a more proactive compliance program, and fostering better public understanding and support of our efforts.

To provide the proper foundation and impetus for our efforts, we're working hard to develop a comprehensive environmental strategy through the auspices of the Senior Environmental Leadership Conference (SELC), and the Defense and Environment Initiative (D&EI). The strategy will be centered on an assessment of the next decade's major environmental concerns; the programs needed to meet those concerns; scheduling actions and funding for DERA; assessment of federal, state and local requirements and their impact on operations, and a detailed analysis of all available environmental information.

While the future will undoubtedly bring changing missions for the Army, the goal of its environmental program will remain the protection and enhancement of our country and its resources.

The need to achieve this goal is well illustrated by the theme of the Army's Senior Environmental Leadership Conference:

> *"We don't inherit the earth from our ancestors,*
> *We borrow it from our children."*

Lieutenant Colonel Werle is serving with the Kuwait Reconstruction Task Force in the Persian Gulf. He was formerly assigned to the Army Environmental Office in Washington, D.C. Previous assignments include command and staff positions in Europe, Turkey and Conus, and a Training-With-Industry tour with the Environmental Protection Agency. He holds a bachelor's degree in mathematics from Virginia State University, and a master's degree in environmental engineering from Virginia Tech. He is a registered professional engineer in Virginia.

Readers wishing to comment on material appearing in ENGINEER are encouraged to address their comments to: ENGINEER Professional Bulletin, ATTN: ATSE-TDM-PB, Fort Leonard Wood, MO 65473-6650. Selected correspondence may be used in the bulletin's upcoming "Letters to the Editor" department.

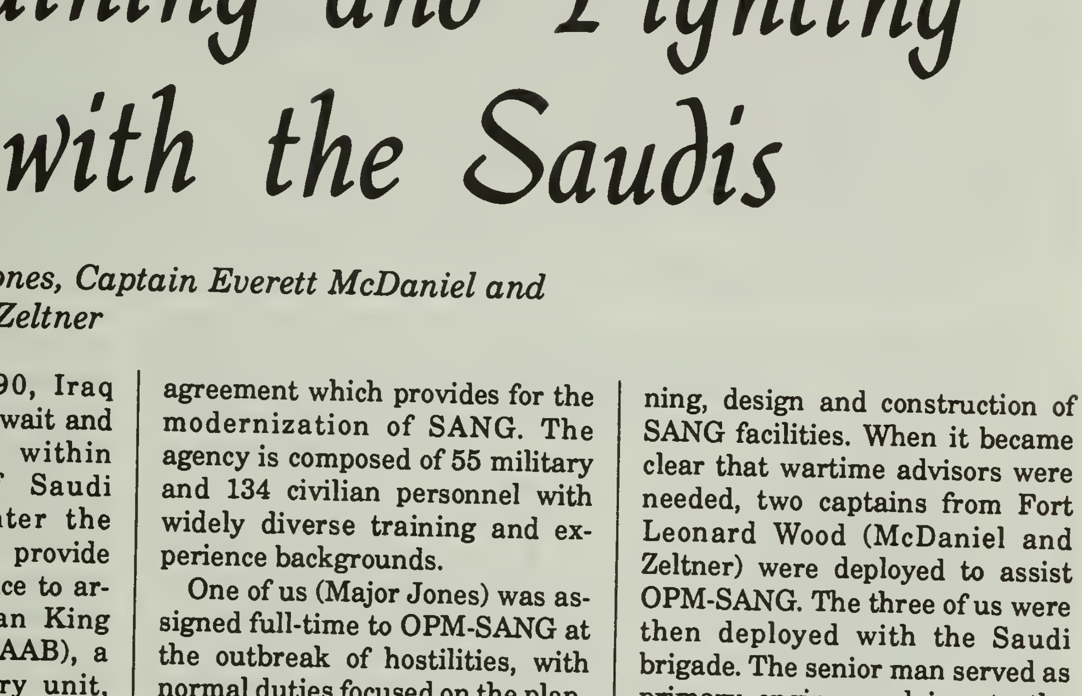
Training and Fighting with the Saudis

By Major John R. Jones, Captain Everett McDaniel and Captain Stephen R. Zeltner

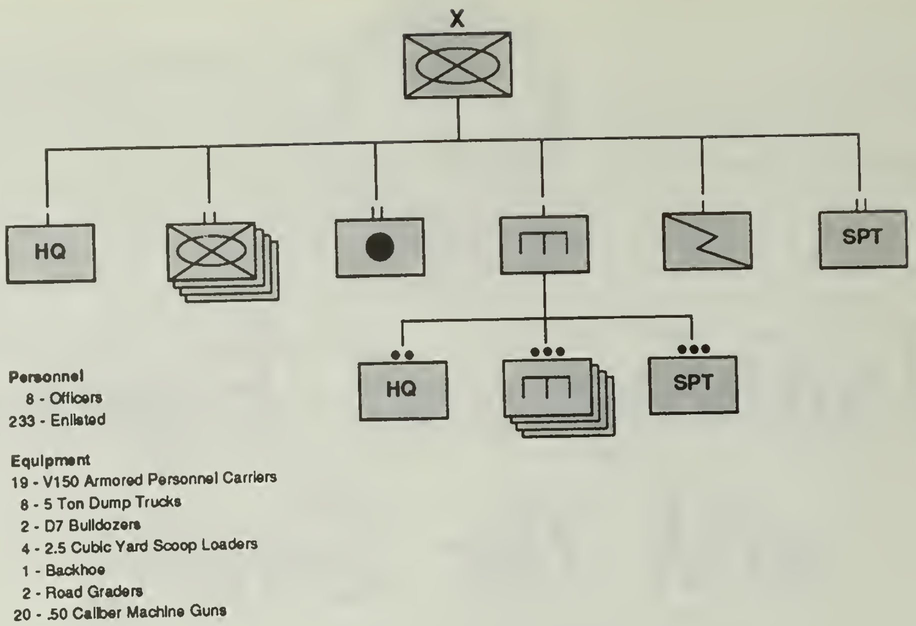
On August 2, 1990, Iraq swept through Kuwait and massed combat units within striking distance of Saudi Arabia. To help counter the threat of invasion, and provide time for outside assistance to arrive, the Saudi Arabian King Abdul Aziz Brigade (KAAB), a National Guard infantry unit, moved to the Kuwaiti border. Within 24 hours, the Saudis were conducting a screening mission along a 60-kilometer (km) front.

We were fortunate enough to have the opportunity to deploy with the brigade, an assignment arranged through the Office of the Program Manager—Saudi Arabian National Guard (OPM-SANG). An American agency headquartered in Riyadh, OPM-SANG provides assistance to the Saudi Arabian National Guard. The agency was formed to support a 1974 U.S.-Saudi cooperative agreement which provides for the modernization of SANG. The agency is composed of 55 military and 134 civilian personnel with widely diverse training and experience backgrounds.

One of us (Major Jones) was assigned full-time to OPM-SANG at the outbreak of hostilities, with normal duties focused on the planning, design and construction of SANG facilities. When it became clear that wartime advisors were needed, two captains from Fort Leonard Wood (McDaniel and Zeltner) were deployed to assist OPM-SANG. The three of us were then deployed with the Saudi brigade. The senior man served as primary engineer advisor to the



An American advisor conducts M17A2 protective mask training with soldiers from Saudi Arabia's King Abdul Aziz Brigade (KAAB) (U.S. Army photo).



Personnel
8 - Officers
233 - Enlisted

Equipment
19 - V150 Armored Personnel Carriers
8 - 5 Ton Dump Trucks
2 - D7 Bulldozers
4 - 2.5 Cubic Yard Scoop Loaders
1 - Backhoe
2 - Road Graders
20 - .50 Caliber Machine Guns

The King Abdul Aziz Brigade

brigade, while the other two served as company advisors.

Unlike the U.S. Army National Guard, SANG is a full-time force. It is capable of conducting short-notice operations anywhere in the Saudi kingdom. Commanded by Crown Prince Abdullah bin Abdul Aziz Al Saud, heir apparent to the throne, SANG is known as the "Ikwan," which means "brotherhood" in English. It is composed primarily of intensely loyal Bedouin tribesmen totally dedicated to the royal family, the nation, and Islam. Major missions include protection of vital installations such as oil refineries, industrial facilities, and communications installations.

Training

Our initial task was to gain the trust of our Saudi allies.

Taking a cue from Special Forces doctrine, we quickly learned their customs and traditions. We lived with the unit, ate the same food, learned their language, and suffered the same hardships. We also took a participatory approach to training that attempted to combine our own knowledge with the Saudis' extensive desert experience. Initially, progress was slow, but as the Saudis' began to see their accomplishments taking shape, pride and comradery soon followed.

In the early days of the crisis, the KAAB was the only combat force on the Saudi-Kuwaiti border. With much of the brigade's attention focused on the Iraqi forces stationed only a few miles away, any time given to training had to be very battle-focused. Working with the Saudi engineer company officers, we helped develop company mission essential task lists (METLs), and prioritized defense-oriented missions. Leader training with the Saudi officers included terrain walks throughout the brigade sector, and the development of a brigade barrier plan.

As Operation Desert Shield took shape, our training activities focused on countermobility and survivability operations. With the increased allied buildup, the possibility of a coalition offensive called for even more intense training. A realistic training area was needed to provide the Saudis with advanced defensive and offensive operations. To accomplish this, we recommended to the KAAB commander that his engineers build a full-scale, company-sized Iraqi strongpoint to facilitate realistic training. He approved, and the resulting construction proved a valuable training tool—not only for the Saudi sappers, but for the brigade's infantry units as well. Because of time constraints, construction and training assistance for the project was provided by the Marine Corps' 1st Combat Engineer Battalion, and the Army's 7th Engineer Support Battalion.

Such joint cooperation boosted the training efforts. The Army's 307th Engineer Battalion also conducted interoperability training with the KAAB, focusing on individual engineer skills and several crew and collective tasks. The 37th Engineer Battalion provided the Saudi's with extensive training on dismounted and mounted breaching operations. The use of live antitank mines, anti-personnel mines, and other demolitions provided the Saudi engineers with the most realistic training they had ever conducted. They performed superbly, and built a renewed confidence in their ability to support the brigade's offensive operations.

To overcome some shortages of equipment and other resources, we

Top: **Gaining the trust and acceptance of the Saudi soldiers was the first step for the advisors. Here, Saudi spiced coffee is served during a break in training (U.S. Army photo).**

Right: **A KAAB soldier prepares Iraqi mines for demolition (U.S. Army photo).**

had to do some quick improvising. For example, a field-expedient minefield marking system was developed with locally available materials. Grappeling hooks were also in short supply, and were needed to support breaching training and operations. Using re-bar and nylon rope, and working with a local American contractor, we were able to fabricate enough hooks to outfit the Saudis. Too, there were no mine probes for the sappers. A quick survey of available equipment resulted in a decision to carve up some Saudi bamboo tent posts into 18-inch probes.

Fighting

As Desert Shield turned to Storm, it was time to see if the hard work and training had paid off. The answer came quickly.

Twenty-four hours prior to the start of the ground offensive, the Saudi sappers got the mission to prepare breach lanes through a complex Iraqi obstacle consisting of a tank ditch, berm and cyclone fence. This obstacle marked the southern edge of the Saudi-Kuwaiti border. The Saudis are not equipped to conduct mounted breaching operations. They lack mineplows, minerollers, and mine-clearing charges. Even so, the KAAB sappers executed the breach superbly. The combat engineer platoons provided site security, while engineer equipment platoons cleared and marked six 10-meter-wide breach lanes through the obstacle.

For its part in the initial allied ground offensive, the KAAB's orders called for the unit to conduct a supporting attack into Kuwait. They had to secure the sector, and clear the coastal highway for use as the coalition's main supply route (MSR) into Kuwait City. Without quick repair of the severely damaged highway, resupply of ammunition, fuel and water would

be severely hampered.

On the morning of February 24, 1991, one of the KAAB's motorized infantry battalions, supported by two sapper platoons, moved through the breaches and into Kuwait. As the infantry secured the first line of Iraqi defensive positions, the sappers began clearing mines along the highway, reconnoitering the area for minefields, and marking unexploded ordnance. Once the area was secured, an engineer equipment platoon began MSR repair and clearing operations. Other KAAB sappers initiated mine clearing operations along the Kuwaiti coast.

The coastal highway in Kuwait is an asphalt, six-lane, divided highway. Iraqi combat engineers had destroyed the three northbound lanes, making a near-term repair effort an act of futility. The three southbound lanes had been cut, tank-ditch-style, about every 100 meters (m) over the first three kilometers. Over the succeeding 7km, they were partially cut at the same interval. Destroyed Iraqi combat vehicles littered the MSR, and several artillery craters in the

Top: **Saudi engineers display the different types of Iraqi mines and munitions they recovered during their breaching and clearing operations in Kuwait.**

Left: **A KAAB infantry squad celebrates their victory after the battle for the town of Al-Khafji (U.S. Army photos by CPT Zeltner).**

Left: **Iraqi forces severely damaged the southbound lane of Kuwait's coastal highway, the main supply route (MSR) for the coalition forces. The northbound lane was completely destroyed (U.S. Army photo by CPT Zeltner).**

Lower Left: **Members of the advisory team prepare captured munitions for demolition (U.S. Army photo).**

highway hindered repair progress.

Within a few hours of starting work, the Saudi engineers had opened one-way traffic. By nightfall, they had opened two lanes of the highway, allowing both north and south-bound traffic. Other KAAB sappers continued breaching operations, clearing a 1,500m minefield, and widening breach lanes through several minefields adjacent to the MSR.

Over the next two weeks, the Saudis continued their clearing and cleanup operations. They filled in more than 3km of the infamous "fire trench" within the first Iraqi defensive belt. They also cleared an additional 6km of Iraqi minefields, destroying over 14,000 anti-tank and anti-personnel mines in the process. Tons of unexploded ordnance were also destroyed.

The Saudi sappers' achievements were extraordinary. Both the Saudi and Kuwaiti royal families, as well as senior American officials, applauded their accomplishments. Eight months of tough, realistic training had paid off. The Saudi engineers returning from the battlefield were a significantly improved fighting force.

While we hope our engineer expertise played a small part in their success, we think another factor deserves a significant portion of the credit: the warrior spirit of the Saudi soldiers. The men with whom we lived and worked were true warriors who had the will to close with and destroy the enemy.

That kind of spirit is something that can't be taught. And because of it, we also returned from the battlefield as better soldiers.

Major Jones served as senior engineer advisor to the KAAB. He normally serves as engineer branch chief, OPM-SANG. Previous engineer assignments include tours with the New York District, and the 3rd Armored Division. He holds a masters degree in civil engineering from Pennsylvania State University, and is a graduate of Command and General Staff College.

Captain McDaniel served as an engineer company advisor in the KAAB. He is assigned to the 589th Engineer Battalion at Fort Leonard Wood. Previous assignments include duties with the 101st Airborne Division (Air Assault), and the 8th Infantry Division.

Captain Zeltner served as an engineer company advisor in the KAAB. He is assigned to the 87th Engineer Battalion at Fort Leonard Wood. Previous assignments include company commander and battalion S1/S4/S4. He also served as company executive officer and platoon leader with the 197th Infantry Brigade.

Tackling Hazardous Waste At Fort Bragg

By Stephen J. Mackmull and George D. Sample

When Fort Bragg found itself with no less than ten hazardous waste sites, an avalanche of regulatory requirements, and an impending environmental nightmare on their hands—they knew it was time to tackle the problem head-on.

When the post issued its first Installation Hazardous Waste Management Plan in June 1990, in coordination with state and federal environmental officials, it found that the administrative requirements for ten separate waste sites were a headache. The plan requires the designation of waste accumulation site managers and weekly inspection of each site by these managers. In addition, it calls for monthly site inspections by the major unit/activity environmental coordinator, and quarterly inspections by the post. The plan also requires training for all inspectors and managers, and annual recertification of these personnel. Since most managers and inspectors are frequently rotated military personnel, the training requirement alone was seen as a significant burden to the post.

To better manage their hazardous waste program, the post's Directorate of Engineering and Housing (DEH) decided to build an accumulation site to consolidate waste storage, utilization and disposal. In addition to eliminating Fort Bragg's relatively large number of dispersed sites, the single facility allows better management of waste materials, provides adequate security, and eases the job of transferring the waste.

A DEH employee takes a sample from an "unknown" fluid brought to their hazardous waste storage site.

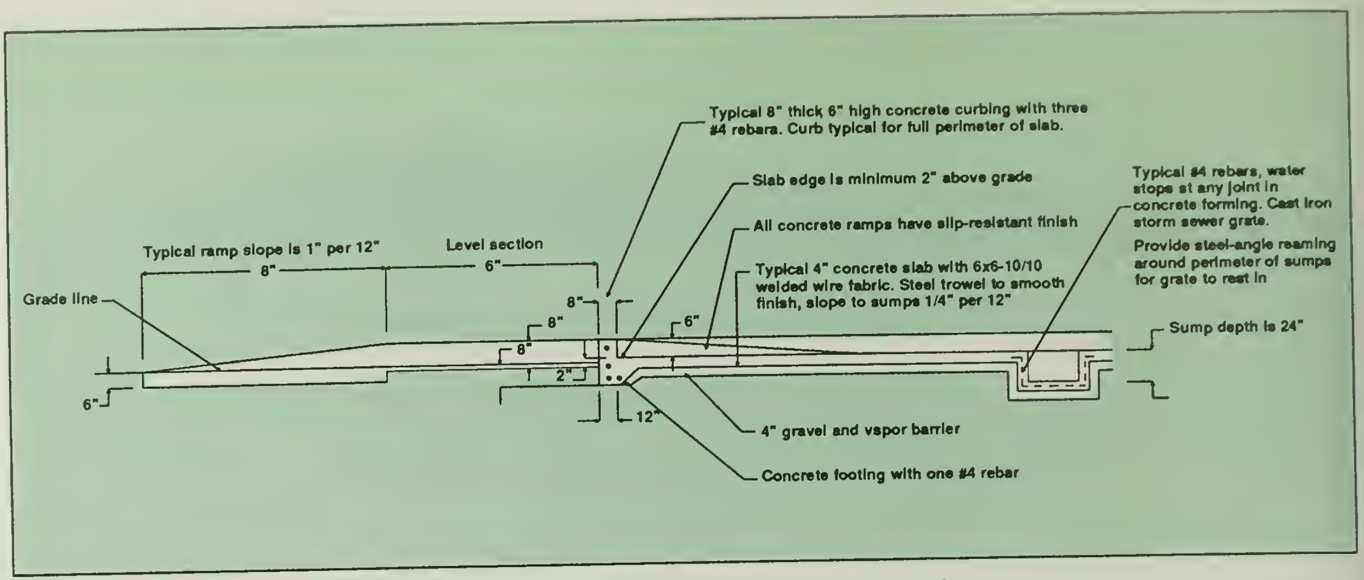
Top: **Fort Bragg's new hazardous waste storage facility. The site provides better control and monitoring of hazardous materials, and improved safety for post employees and residents.**

Above: **A forklift eases the job of moving large drums of material inside the facility.**

Site Design

The site was designed by DEH's Design Branch, in cooperation with the organization's Environmental Branch. The storage area, or pad, measures 30 feet by 60 feet. The floor is 4-inch-thick, 3,000 pounds-per-square-inch (PSI) concrete, with a 6-inch curb surrounding the entire pad. The pad has two sealed sumps, 24 by 24 by 24 inches, to catch any spills from stored materials.

The facility has no walls, and the roof—with its 36-inch overhang—is supported by 18 6-inch by 6-inch timbers. The site includes two fluorescent light fixtures, and one 110-volt electrical outlet. All electrical items are vapor-tight, industrial cast aluminum. A freeze-proof safety shower and eye wash assembly was also installed at one corner of the pad. Drainage is maintained within the pad's 6-inch curb, for obvious safety reasons.


Typical 8" thick 6" high concrete curbing with three #4 rebars. Curb typical for full perimeter of slab.
Slab edge is minimum 2" above grade
All concrete ramps have slip-resistant finish
Typical 4" concrete slab with 6x6-10/10 welded wire fabric. Steel trowel to smooth finish, slope to sumps 1/4" per 12"
Typical #4 rebars, water stops at any joint in concrete forming. Cast iron storm sewer grate.
Provide steel-angle reaming around perimeter of sumps for grate to rest in
Sump depth is 24"
Typical ramp slope is 1" per 12"
8"
Level section
6"
Grade line
8"
8"
8"
6"
2"
6"
12"
4" gravel and vapor barrier
Concrete footing with one #4 rebar

Section through ramp, curbing and sump pits

A 9-foot-wide concrete ramp leading to the pad allows personnel to move hazardous materials by forklift. The site is surrounded by a 7-foot-high chain-link fence, topped with barbed wire. The ground between the storage pad and the fence is covered with crushed rock.

Waste Sources

Most of the toxic and hazardous waste used or generated at Fort Bragg is tightly controlled, and is part of a "continuous waste stream" system. That is, it comes from sources that generate such waste as part of their daily operations. Such materials include waste paints, used photographic chemicals, chemical cleaning solutions, and used oils. These wastes are carefully collected, placed in appropriate containers, tested to ensure their chemical composition, and then transported to the Fort Bragg Defense Reutilization and Management Office (DRMO). Civilian waste disposal companies, under contract with DRMO, then take charge of this waste.

The rest of the hazardous waste, and the kind most often handled at the accumulation site, is usually the result of what we call "one-time events." For example, a particular job on the post may require the use of a toxic chemical, a toxic solution may result from mixing two or more chemicals, or suspected toxic material is found somewhere on the installation. Such materials often come from cleanup operations, and include decontamination solution No. 2 (DS-2), and supertropical bleach (STB).

One of the biggest sources of toxic waste is the so-called "mystery drums." This catch-all phrase includes long-forgotten containers of various sizes found in wooded areas, behind barracks, in motor pools, and any other conceivable location. These containers are usually rusted and unlabeled, requiring storage in the accumulation site while tests are made to determine the contents.

Sometimes, new containers are mislabeled, posing a potential toxic risk to employees. Recently a motor pool labeled a group of containers as "used lead-acid battery electrolyte." However, a spot check by a waste management contractor found that several containers did not contain battery acid—but another potentially dangerous chemical. This batch of chemicals was placed in the "unknown" section of the accumulation site to await analysis.

Waste Disposition

The accumulation site's pad is divided into pallet-sized storage zones (see illustration next page), with specific areas for flammables, corrosives, oxidizers, reactives, and unknown materials.

Incoming wastes are placed in the appropriate storage zone for up to 90 days. "Mystery" containers are sampled and analyzed. When the test results are known, the material is moved to the proper zone to await removal. Material in deteriorated containers is repacked and labeled correctly for subsequent transfer. Most materials temporarily placed in the accumulation site are ultimately transferred to one of DRMO's waste contractors for proper disposal.

There are a couple of exceptions, however. If flammability is determined to be the only hazard associated with material brought to the site, it may be taken to the 82d Airborne Division's heating plant. The plant is authorized to burn waste oil products, providing the products meet certain environmental criteria. Recently, a rusted drum with no labels or other markings was found on post. The bung seals, while badly deteriorated, were still in place—indicating that the drum had not been opened. Testing revealed that the drum contained petroleum naphtha, which can be burned by the heating plant. The drum itself, after being thoroughly drained, will be taken to a local landfill. Non-flammable materials, if testing reveals that they pose no toxic danger, will also be deposited in the landfill.

Minor Problems

Some lessons were learned during site construction. The initial ramp to the pad turned out to be too narrow. The original 6-foot ramp was wide enough for a forklift to move materials up to the pad—but only if it was perfectly positioned. However, in hindsight, we felt that toxic and hazardous materials needed more of a safety margin than "just wide enough." The ramp was widened to 9 feet before the site was officially opened.

We also found that grates over the sumps would not support the weight of a forklift because the rim around the inside of each sump was too weak. Three inches of angle iron was subsequently added around each sump to correct the problem.

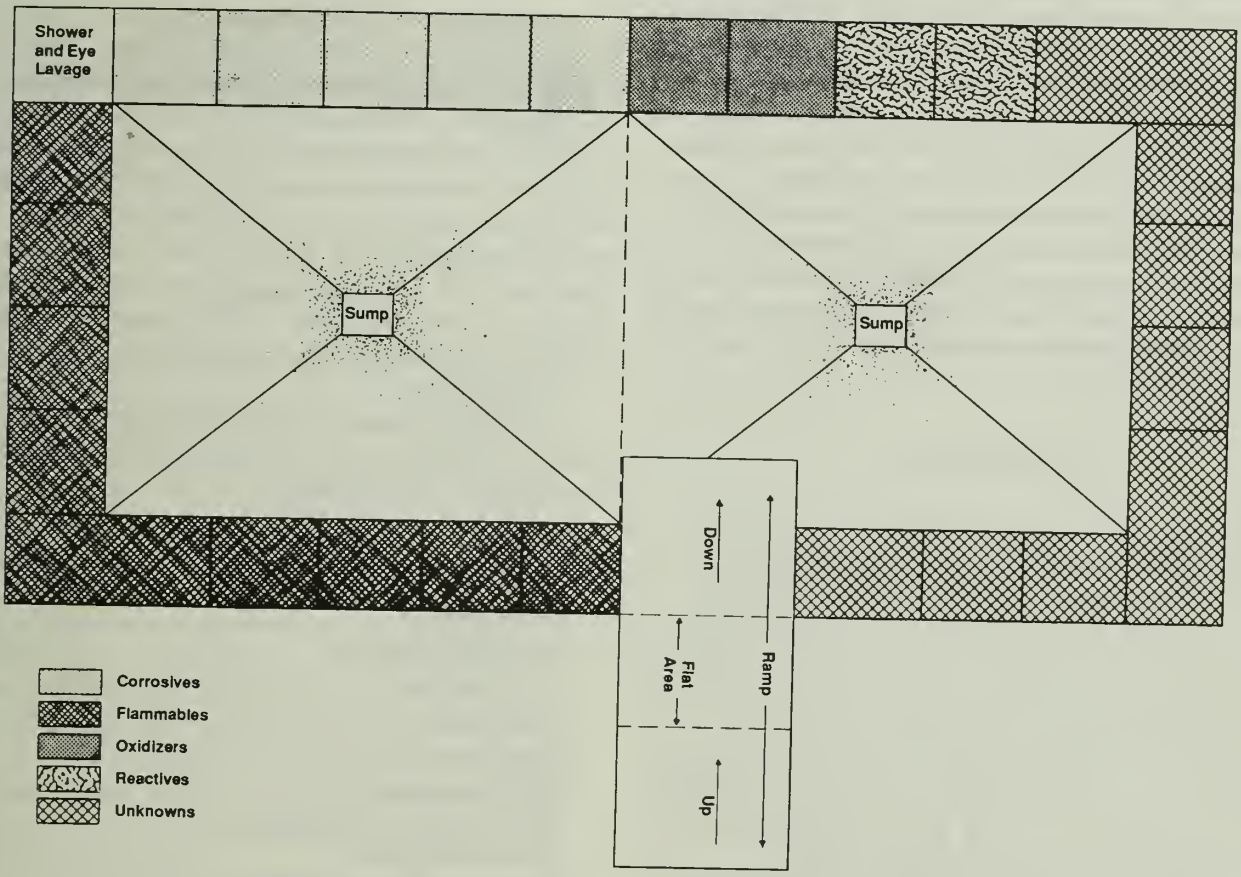
A Success Story

Fort Bragg's accumulation facility has been a proven success. During calendar year 1990, the site played a major role in helping the post eliminate more than 400,000 pounds of hazardous waste. The site has also helped to facilitate management of toxic and hazardous wastes, improve safety conditions for Fort Bragg personnel and their families, and brought the post into compliance with current state and federal environmental regulations.

Military or civilian engineers interested in more information on the accumulation site are invited to contact George Sample or Stephen Mackmull at Autovon 236-3341 or commercial (919) 396-3341.

Mr. Mackmull is an environmental engineer and chief of the Environmental Branch of Fort Bragg's Directorate of Engineering and Housing.

Mr. Sample is a chemical/environmental engineer and the hazardous waste manager for Fort Bragg's DEH.



Storage Area

Area Damage Control: The Forgotten Mission

By Major Edward M. McClure

When enemy action, accidents or natural disasters wreak havoc in the rear area, it's usually engineers who are tasked to lead the restoration effort. While I have no doubt that we are capable of handling damage control, we don't usually get much training or guidance on how to do it. This article is intended to serve as a primer on planning and executing damage control in the rear area of operations, division and corps rear areas, and the communication zone (COMMZ).

Area damage control (ADC) is described in FM 90-14 and FM 90-23 as "Measures taken before, during and after hostile action or natural or manmade disasters to reduce the probability of damage and minimize its effects." Note that this definition calls for minimizing the effects of damage, not damage itself. Damage control is not the same thing as damage repair. There are five basic principles of damage control that I'll cover through the article.

Principle #1

Repair—rebuilding something back to its original state—takes place after control. This is the first and most important principle of damage control. Translating this into operational terms, the ADC mission is to ensure freedom of action and restore operations. This is accomplished by preventing damage, preparing for expected damage, and responding to damage after it occurs.

ADC is an operations function, although FM 90-23 overemphasizes the role of engineers in ADC. ADC actions have a direct impact on the commander's ability to complete his missions and take care of his soldiers. The impact may be direct, as in cases of soldier injuries, damage to militarily-useful facilities, and destruction of equipment. Indirect impact includes diversion of manpower and equipment from primary missions, interference with movement, and degradation of morale.

Principle #2

Area damage control is not exclusively an engineer mission. In fact, the primary operators in ADC missions are the soldiers in or near the affected areas and facilities. However, eight times out of ten, local engineers will be tasked to take care of the problem—or at least lead the ADC effort. But engineers cannot do the job alone, even with host nation assistance. Even simple ADC efforts require circulation control and communications.

Almost everyone in the rear area has an ADC mission. These are some of the non-specialized functions of an ADC effort:

Rescue
First Aid
Firefighting
Communications
Earthmoving
Evacuation
Site Security
Reconnaissance
NBC Reconnaissance
Decontamination
Mess and Water Supply

These are the specialized functions normally performed by specific types of units:

Heavy Earthmoving	Engineers
Demolition	Engineers
Construction	Engineers
Facilities Inspection	Engineers
Road and Bridge Recon	Military Police
Circulation Control	Military Police
Combat Patrolling	Military Police
Crowd Control	Military Police
Large-Scale NBC Decon	Chemical
Ordnance Disposal	Explosive Ordnance Disposal (EOD)
Emergency Medical Care	Medical
Medevac/Dustoff	Medical
Long-Range Commo	Signal
Supply	Support
Transportation	Support
Maintenance	Support
Civil-Military Liaison	Civil Affairs
Graves Registration	Adjutant General's Corps
Personnel Accounting	Adjutant General's Corps

In addition to these, numerous resources are provided by other services, allied forces, civilian contractors, local civilians, and the host nation.

The rear command post (RRCP), rear tactical operations center (RTOC), or rear area operations center (RAOC), will coordinate the ADC plans and operations for its area of responsibility. If these control centers are not available to oversee ADC operations, engineers are most frequently nominated to run the show.

Principle #3

The best way to control damage is to prevent it from happening. Terrain managers can control damage by exploiting readily available natural and man-made cover and concealment, and by dispersing and concentrating, as appropriate, troops and facilities. Then, we can look at enhancing cover through site hardening, and concealment through additional camouflage.

Units, bases and base clusters need to start with self-help, using organic resources, and then request support through normal organizational channels. Decisions about who gets scarce resources must be coordinated at the RAOC/RTOC/RRCP.

The principles of METT-T (mission, enemy, terrain, troops, resources available, and time) apply to this decision process.

In setting priorities for ADC protection operations, determine the mission-essential activities and facilities for the division, corps and theater. Note that we are not looking at the rear area's mission, but the mission of the entire command.

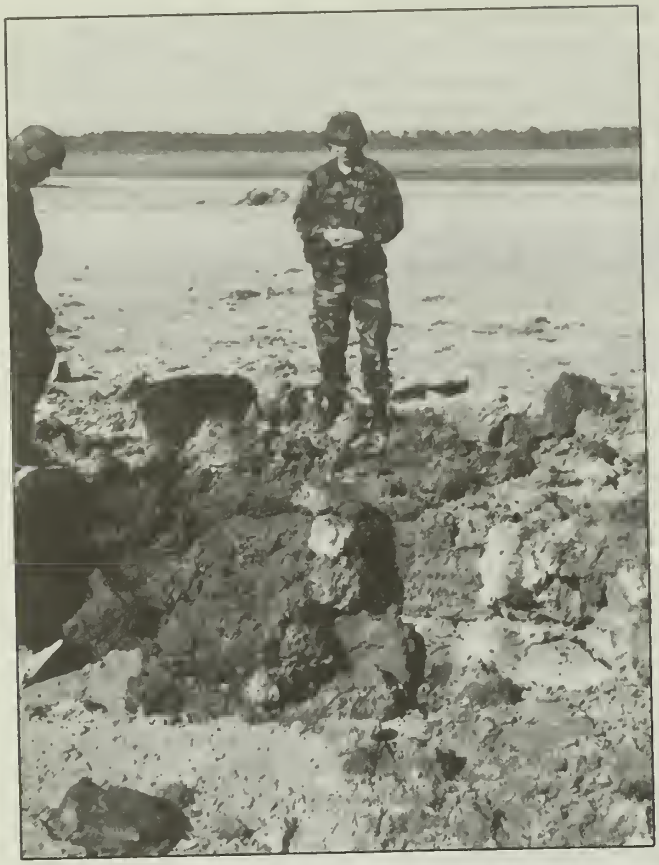
Then we must identify the threats: enemy, accidental, and natural. Both the likelihood of the threat(s) and the vulnerability of personnel, facilities, systems or operations must be evaluated. The result of this estimate process should be a set of priorities for ADC operations, which are then translated into mission orders and Class IV supply guidance.

Principle #4

There are never enough resources or time to do everything. The priorities we developed to guide the prevention effort also serve as a pattern for our response to damage. Somebody must set the priorities for ADC response operations, and it must be somebody with sufficient authority to make them stick when the going gets rough—like the division commander or assistant division commander. When the damage is done and things need to get fixed in a hurry, it's too late to go through an analytical process to determine who gets the relief effort. And the need to get facilities and operations back on track is too critical to allow subordinate commanders to squabble over who gets what slice of the ADC pie.

As far as possible, analyze your potential ADC problems in advance, gauge your ability to respond to them, and get some priorities down on paper. Identify and continue to monitor the status of ADC assets, especially heavy engineer equipment, chemical decontamination units, and emergency medical capabilities. Identify and monitor the ADC resources available in units, bases and base clusters. Determine the distance between bases and their ADC assets. In other words, how long will it take to get the nearest decon platoon to a certain base? The monitoring process must be continuous and must track both commitments and movements. The bottom line is knowing where your ADC assets are, and what their capabilities are at any given time.

Review the positioning of units from an ADC perspective. We've already looked at cover and concealment, dispersion and concentration, and vulnerability. Now consider access to ADC assets for the bases, and the disposition of the ADC assets themselves. Do they match the load? Are they where they need to be to get the job done? Do we have high-priority bases that are too far away from medical, chemical, or engineer support? Do we move the base, move the asset, or just sweat?



Top left: Engineers make a damage assessment of cratered runway. In wartime, repair of such damage is likely to be a major focus of engineer effort.

Top right: A soldier compacts soil in a crater as part of the repair process.

Above: Engineers clean up the edges of the concrete surrounding a bomb crater.

Whatever level you're at, remember to advise your higher headquarters and the local RAOC/RTOC/RRCP if there is an unfilled need or an uncovered vulnerability.

Local measures are the foundation of effective damage control. Every level—unit, base, base cluster, and higher—needs to plan and coordinate response to damage. Develop generic responses to general categories of threats. Develop specific contingency plans for likely, dangerous and known threats. Identify specific local vulnerabilities. In addition to coordinating with the potential "victims" and ADC assets, coordinate with the command and control systems in the rear area, including the movements control center (especially the highway traffic headquarters, or HTH). the echelon's logistical headquarters (DISCOM, COSCOM, Area Support Group), and higher and adjacent headquarters.

Part of this preparation process is a review of lower level ADC plans. You need to make sure that units, bases and base clusters for which you are responsible know how they are going to conduct ADC operations. Each individual unit or base plan must have procedures for identifying and monitoring ADC resources, both on and off base. For example, where is the nearest surgical facility, and how will casualties be transported?

Each base must have an alarm system with distinct signals (air attack, ground attack, NBC attack, fire, and all-clear). Base plans must also direct units to furnish ADC reaction teams for firefighting, NBC reconnaissance, NBC contamination, casualty transport, first aid, light rescue (with jacks, shovels, rope and pry bars), heavy rescue (with wreckers, forklifts, and vehicle-mounted winches), and EOD reconnaissance. Personnel must be organized, trained and rehearsed. Personnel accountability and emergency supplies must be included in the plans, along with alternate operating locations and rally points.

The unit, base and base cluster ADC planning process is basically the same as that used at higher levels: What are our most important facilities? (Note that this question must be based on guidance from higher headquarters in the tactical chain of command. The local base commander may not know what facilities are the most important for his higher command's current operations.) What are the threats? How does each threat affect each facility? What do we have to do to preclude damage? What time and resources do we have available? How will we respond to identified contingencies?

Finally, contingency plans must be rehearsed or they won't work when they're needed. Unit, base, base cluster and area commanders must supervise. Rehearsals are a pain, and drumming up any enthusiasm for them is a challenge for commanders. But no plan will work effectively without practice, especially for operations as potentially complex as ADC.

When your area is hit, and ADC is implemented—you will probably find that even well-planned efforts will be stretched beyond their capabilities.

Your first step is to assess the damage and/or contamination. This requires information. If bases in the impacted area do not conduct the necessary reconnaissance, then you will have to direct it. Technical experts—engineers, signal, ordnance, and chemical—may be needed to determine:

- What happened and where?
- What impact does it have on operations?
- How do we get around it or do without it?
- What time and resources do we need to get it operational?

Report the extent and location of the damage to the RAOC/RTOC/RRCP, higher headquarters and relevant command and control systems as soon as possible. For example, the movements control center (MMC), or movements control agency (MCA) in the COMMZ, needs to know about road and rail problems immediately so they can reroute convoys and trains. If an airfield is knocked out, the support command needs to know that supplies cannot make it through. The intelligence community needs the information to pick out patterns in enemy behavior that indicate their intentions.

At the scene, isolate the danger area and prevent continuation or extension of the damage. Mark contaminated areas and keep traffic out so possible contamination cannot spread further. Troops in a contaminated area must remain there until a decontamination site is established and a safe route is established to it. Make sure this route does not cross any important roads or pass anything else of importance to the operational effort. Prevent fires from spreading by clearing firebreaks. Mark and rope off unexploded ordnance and other hazardous areas.

When it comes, you won't find damage in isolated incidents. You will usually have many things happening at the same time. And you won't have the resources or time to deal with all incidents at once. Look at your priorities, swallow hard, and start at the top of the list. Then, conduct an "ADC triage" by posing three questions for each case:

- First, does it have an impact on operations? If not, go to the next case. You have a war to fight, and damage that doesn't impair or threaten operational capabilities will have to wait until later.
- Secondly, will your efforts help? Will it do any good? If nothing can be done to restore the base or facility to operation, then don't waste time or resources on it. Just like a medical triage situation, hard decisions are required. But you do not have the luxury of taking care of hopeless cases.
- Lastly, can the damage be controlled by on-scene personnel? If local base resources can deal with it (fighting fires, clearing rubble, filling craters), then let them do it and get your people to more critical areas.

Next, determine what is needed to restore operations and ensure freedom of movement. This is a three-step process:

- Determine which operations and movement routes are really required. Ask yourself:

What does this facility, bridge, road, or unit contribute to the mission? Answering this question requires a depth and breadth of knowledge about combat, combat support, and combat service support operations—as well as access to appropriate staff planners and operators. If you have done your priority analysis well, this information will be at your fingertips.

- Once you know the value of the damaged facility, determine what level of restoration is required to reach the needed level of operation. Remember, more extensive or long-lasting repairs can wait until after the war. We just want to get operating again. For example, you may need to clear rubble off a highway, but only enough to open one lane—not two. You may need to replace a bridge, but only up to class 24—not 60.
- Finally, translate those critical requirements into specifics: blade hours, soldier-shovel hours, medics, EOD specialists, fixed bridge bays, and so on. Again, you'll need technical specialists for this process unless you make yourself knowledgeable in fields other than your own. Learn how much of each resource is required to take care of each kind of problem. This may be the most difficult part of organizing damage control responses. Often you will need to rely on the analysis of soldiers on the scene. If you have the opportunity, train them to make good ADC estimates. Keep a reference guide so that your successor can use the same knowledge without having to "re-invent the wheel."

Once you know what needs to be done, somebody has to make it happen. Someone in authority must task units and personnel to take care of the damage. An SOP annex will not make it happen. One practical thing I've learned from ADC operations is that this requires someone who can speak for the corps or division commander. If the order does not come from someone in the tactical chain of command, it won't get done. Operators in the field have many pressures—so many tasks, missions, and requests—that the damage control effort will be pushed low on the list unless significant command attention is brought to bear.

The operations order (OPORD) for an ADC response uses the same principles as any other OPORD. The usual five-paragraph field order works just fine. A few things, however, need special attention. In a tactical OPORD, unity of command is not a problem; it comes with the tactical organization. In ADC operations, it's not that simple. The base and base clusters contain many command structures. Add the ADC response forces, and it can be a real nightmare. You must ensure unity of command at the site by setting out a clear task organization. Based on METT-T, you can either place the response forces under the base commander, base cluster commander, or vice versa.

Principle #5

Everyone in the impacted area must be placed under the control of one commander. That commander must mesh operational priorities in the OPORD with the resources available to control damage and resume operations.

In summary, when you're planning or implementing area damage control, remember these points:

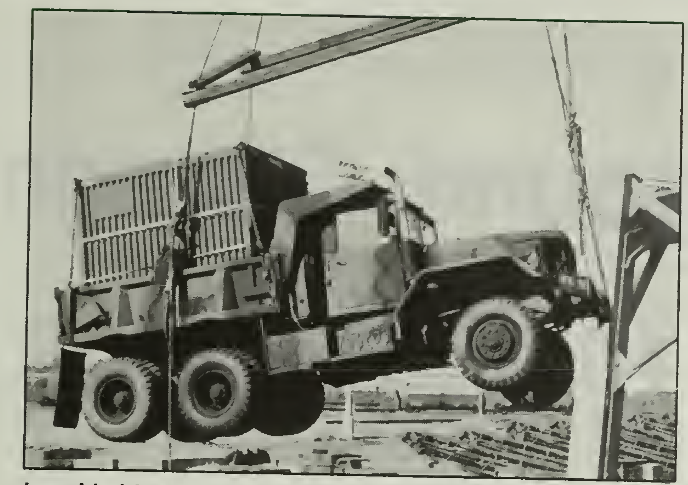
- Unity of command is vital to getting the job done. Somebody has to be in charge.
- There are never enough resources or time to do everything. Do a triage of each situation. We get paid to make hard decisions.
- The best way to control damage is to keep it from happening in the first place.
- Engineers are not alone when damage hits. Know what everyone else does, and use them.
- Your mission is to restore operations—not repair facilities.

Damage control is a combat multiplier that, when properly conducted, can minimize the enemy's ability to affect your operations. Make it happen.

Major McClure is an engineer officer and member of the North Carolina National Guard. He currently serves as an assistant professor of military science at North Carolina State University at Raleigh. Previously, he served with the 139th Rear Area Operations Center—the first RAOC deployed in Desert Shield/Desert Storm. He has also served as commander of an area damage control task force, and worked as a Middle East analyst for Intelligence and Security Command.

Safe Port Operations

The timely shipment of thousands of tons of equipment, ammunition, and supplies was critical to our victory in the Gulf War. This task required the orchestration of several Department of Defense agencies and all aspects of port operations, including port support activities (PSA).


Lopsided loads are a common hazard during load-up operations. This truck's center of gravity changed due to the weight and height of the secondary load. As the truck was lifted it began to lean dangerously toward the heavier side.

For the Engineer Branch, PSA are a necessary and recurring part of our deployments. And all facets of PSA, rail movements, staging, and ship loading/off-loading operations, have inherent hazards.

Army leaders must assess these hazards to prevent or minimize the number and severity of mishaps and injuries their soldiers sustain. They must inform soldiers about the risks associated with each part of a port operation. As in any activity, the success of our prevention efforts depends on how well we communicate.

The tailgate session is a successful method of presenting a safety message. Its name came from the practice of employees sitting beside a truck's tailgate while they listened to their supervisor's safety briefing. Tailgate sessions are effective because they allow a supervisor to describe specific tasks and associated hazards at the job site—where the rubber meets the road. Supervisor involvement lends authenticity to the safety message.

The following safety tips apply to port support activities in any deployment situation. Use them to develop and implement a meaningful accident prevention plan for your unit.

- Commanders, ensure that PSA personnel are given specific guidance on their duties before they start an operation.
- Warn all personnel about smoking in unauthorized areas, and that violations will not be tolerated.
- Ensure that all soldiers are drownproofed; develop and practice a soldier-in-the water drill.
- Brief port operators on how to safely climb on a helicopter covered with shrink wrap.
- Ensure all helicopters on board a vessel are properly grounded.
- Clearly mark tie-down points and lift points to avoid confusion.
- Brief your personnel not to stand under cargo as it is being hoisted.
- Inspect rail car spanners for potential instability.
- Ensure cargo and secondary loads are secured before loading them aboard the vessel.
- Ensure only licensed/qualified operators are allowed to operate loaded equipment.
- Alert your personnel that commercial stevedores often back vehicles without ground guides.
- Never allow personnel to walk in front of a vehicle that is coming down a ramp.
- Avoid stopping a vehicle midway on a ramp; this practice may result in clutch damage or brake failure.
- Brief soldiers never to stand in front of a parked vehicle when ground guiding another.
- Remind soldiers to use hand tools correctly and never to use a body part as a tool.
- Enforce the use of personal protective devices for head, eyes, ears, hands, feet, and lungs.
- Brief proper lifting techniques: Think before lifting. Analyze the task. Get help. Find a better way. Save a back or muscles from injury.
- Keep the work area clean. Look for surface hazards before starting an operation.
- Know the hazards associated with pressurized hoses and energized wiring. Decompress or disconnect—save a limb or a life.
- Split rim tires can kill. Always use a safety cage. Use only tools designed for mounting and demounting tires.

Leader involvement is required for a successful safety program. Safety is a graded exercise, and a single preventable mishap may cause you to fail. Supervisors must review their daily activities and assess risks before a job is started. Commanders must keep their standing operating procedure current with changing missions and unit equipment.

By Captain Miguel Torres, Engineer Branch Safety Manager, Fort Rucker

Underground Storage Tanks:

The Silent Menace

By Scott Murrell

Most underground storage tanks are made of steel, which started corroding the day they were placed in the ground.

The story is becoming all too familiar. Someone turns on their kitchen faucet one day and finds water reeking of gasoline. The bewildered person calls the fire department and the utilities company. There's no immediate fire hazard, but further investigation reveals that the ground water has been contaminated by gasoline from a neighborhood filling station. The sole water source for the neighborhood is now undrinkable, and will probably remain so for years.

The gasoline contamination was caused by a leaking underground storage tank (UST), one of hundreds of thousands buried all over the country. While putting gasoline and oil tanks underground minimized fire hazard problems and improved esthetics, it also gave us a monumental environmental problem. Most USTs are made of steel, which started corroding the day they were placed in the ground.

As these tanks aged, corrosion caused tiny holes in many of them. Gasoline and oil leaks usually took place slowly—too slowly for the owner to notice the problem. By the early 1980s, some experts estimated that 25 percent of all USTs were leaking. Many private water wells and some municipal water supplies became contaminated. In the state of Missouri alone, some 6,000 leaking USTs have been discovered, enough to contaminate the state's entire ground water supply if corrective action was not taken.

As the scope of the UST problem became apparent, the Environmental Protection Agency (EPA) began to take action. In 1988, the Resource Conservation and Recovery Act was amended to provide close regulation of USTs. The new legislation calls for determining the location of all existing USTs, and requires their owners to conduct leak testing. Leaking tanks must be repaired or replaced. Corrosion protection systems must be installed on all existing tanks by 1998, and new tanks must be double-walled, and made of corrosion-proof materials. New tanks must also be equipped with sensors which sound an alarm if a tank develops a leak.

Fort Leonard Wood

A decade ago, Fort Leonard Wood had hundreds of USTs. Over the post's 50-year history, almost any unit with vehicles had been given its own fuel storage tanks. More than a hundred of the post's USTs were large gasoline and diesel fuel tanks. Many small heating fuel tanks were also spread throughout the installation.

Beginning in the mid-1980s, in anticipation of the new regulatory requirements, the post's Directorate of Engineering and Housing began to remove unneeded USTs. By the time the new regulations started taking effect in 1988, the post still had 74 regulated tanks that had to be registered with the Missouri Department of Natural Resources (MDNR). These tanks were then prioritized for a testing and upgrade program.

During 1988 and 1989, tanks at the post airfield and at a unit motor pool were discovered to be leaking and were removed. Both tanks had contaminated small amounts of soil, which were easily removed. The MDNR was satisfied with our cleanup efforts, and our experience to that point seemed to indicate that USTs were not going to pose a significant problem. However, this turned out to be the proverbial calm before the storm.

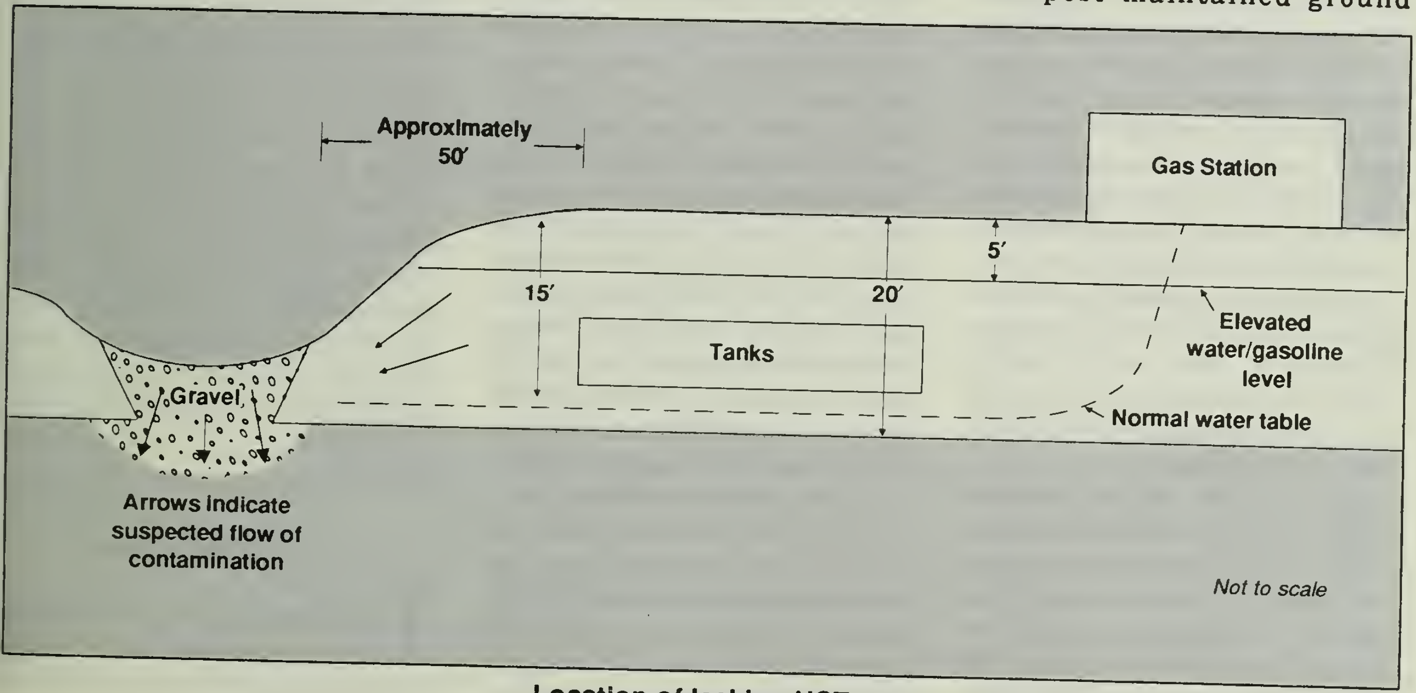
The Gas Station

Two years ago, DEH turned its attention to four large gasoline tanks located at the post exchange service station. Since inspection of these tanks would involve considerable excavation, a decision was made to go ahead and put in new fuel pumps and supply lines that had been scheduled for installation later. The entire project had an estimated cost of $400,000, and the service station was expected to be closed for about four months.

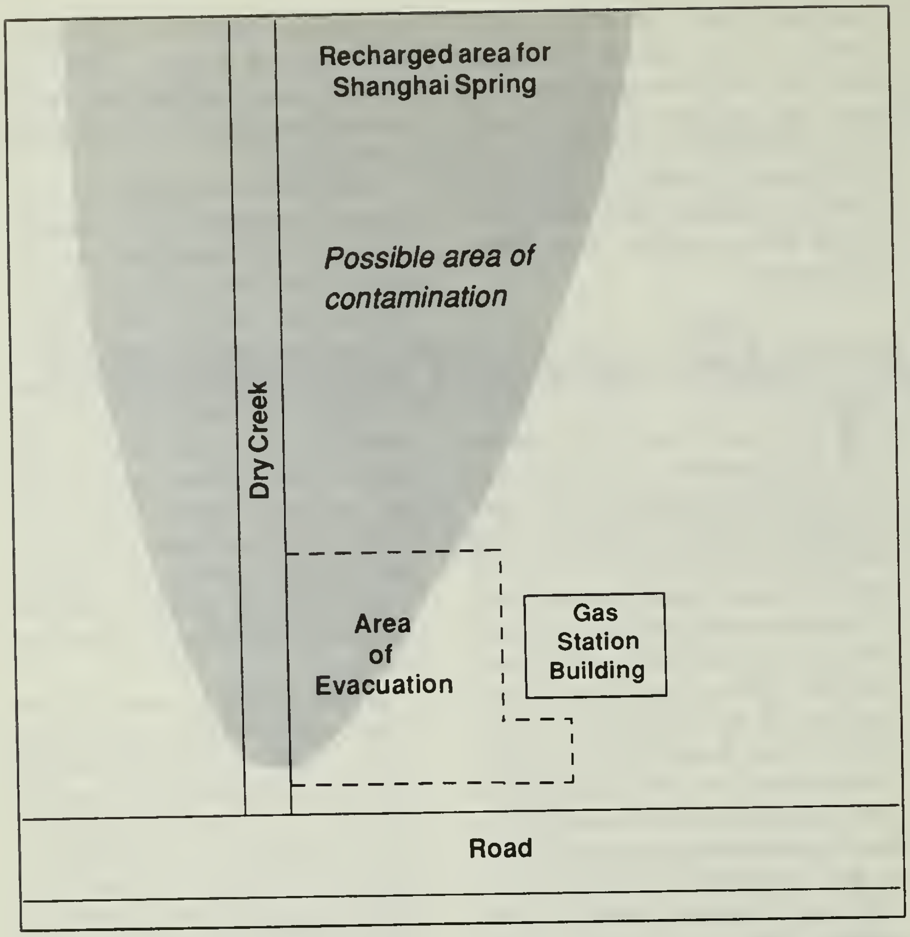
But in February 1989, before work on the project had begun, the service station manager reported discrepancies in gasoline inventories. Leaking tanks were suspected, although there was no outward evidence of this. As required by the new storage tank regulations, the post notified the MDNR and began drilling a ground water monitoring well to determine what was happening underground.

Confirmation of fuel leaks was almost immediate. The monitoring well was positioned over the service station's parking lot. As soon as the drill penetrated the pavement, gasoline welled up in the hole. Further drilling at that location was deemed too dangerous, and other spots were chosen some distance away. Drilling at these locations found ground water at about 20 feet. As soon as this level was reached, several feet of gasoline immediately accumulated in the well casing.

At this point, it was obvious that the gas station posed a more serious UST problem than our earlier tank projects, but we still believed that the contamination was localized. A project to replace the tanks was still in the design stage, and was not scheduled for completion until later that year. The MDNR agreed to delay a full-scale excavation of the site until the UST replacement project was ready. As part of the agreement, the post maintained ground



Location of leaking USTs


Recharged area for Shanghai Spring
Possible area of contamination
Dry Creek
Area of Evacuation
Gas Station Building
Road

water monitoring wells, and periodically pumped out leaking gasoline that accumulated in the wells.

The service station was built in 1959, on a site which originally had been a deep valley. Half of this valley had been filled with earth to provide space for the pumps, storage tanks, and a parking lot. A small creek flows through the valley along the bottom edge of a 20-foot-high earth fill embankment bordering the station parking lot. In hindsight, it should have been apparent to the original project engineers that any spilled gasoline and diesel fuel would pass easily through the relatively loose fill material.

Replacement of the station's USTs began in December 1989. Following removal of the tanks, we began to excavate soil from the surrounding area, testing for contamination as we went. The MDNR required that any soil remaining in the excavation zone show a contamination level of less than 100 milligrams of total hydrocarbons per liter. But as the hole grew deeper and wider, contamination levels stayed well above acceptable levels. Veins of contaminated soil snaked off in several directions from the original site of the leaking tanks. Weeks turned into months as backhoes tried to dig out these contaminated veins. By the end of the summer, almost 11,000 cubic yards of contaminated soil had been removed from the service station site. Although some contamination had "snaked" under a nearby four-lane highway, and under the main station building itself, the MDNR declared the site cleanup complete—but only for the immediate service station area. The worst news was yet to come.

The Creek

Contamination from the leaking USTs had reached the creek at the bottom of the valley. Water and soil samples from the creek indicated that gasoline had permeated the gravel streambed, and levels of contamination were well above the allowable level. The DEH is now in the process of investigating the extent of contamination, and will be responsible for Fort Leonard Wood's obligation to clean up the creek.

When the service station reopened in December 1990, the total cost of the project had reached $800,000. Over half that amount consisted of UST contamination cleanup costs. The station is now equipped with four 10,000-gallon, double-walled, fiberglass tanks with double-walled fiberglass connecting pipes. The tanks and pipes are also equipped with electronic leak detectors.

In the early stages of this project, we had no idea of the full magnitude of the problem. Up to this point, we had not encountered serious problems with USTs. The few "leakers" we had dealt with were easily cleaned up by simple excavation. Unfortunately, we also believed that excavation was the answer to the service station USTs. This turned out to be a significant error. The entire project was delayed by the massive earth moving requirements, and by the need to obtain new project funding at the start of a new fiscal year. During the entire year-long project, the post was without a service station.

In Retrospect

If we had the chance to do it over again, how would we go about it? A more logical approach

The service station's new USTs await installation. The fiberglass tanks are corrosion-proof, double-walled, and contain electronic leak detection devices (U.S. Army photo).

would have been to tackle the leaking USTs and the soil/water contamination as separate projects. Temporary, aboveground tanks could have been installed to keep the station operational while the UST problem was studied further. With more time to study the problem, and with more monitoring wells and soil samples, we could have identified the true magnitude of the problem before we began moving dirt. Conceivably, excavation may not have been the best choice for cleanup of the site.

Three basic methods exist for cleanup of underground contamination. Excavation is the most common, with subsequent disposal of the contaminated soil in a sanitary landfill. This is a relatively inexpensive method, as long as small amounts of soil are involved. But it has the drawback of posing potential problems at the landfill site.

A more permanent solution is soil excavation, followed by incineration. However, this is extremely expensive.

The third method is treating the contamination in sutu, that is, without soil excavation. This usually involves a pumped well, positioned to lower the water table under the area of contamination. A cone of depression is then created in the water table, trapping the contaminates and preventing their further migration. Oil products are easily recovered from the extracted water by gravity separators.

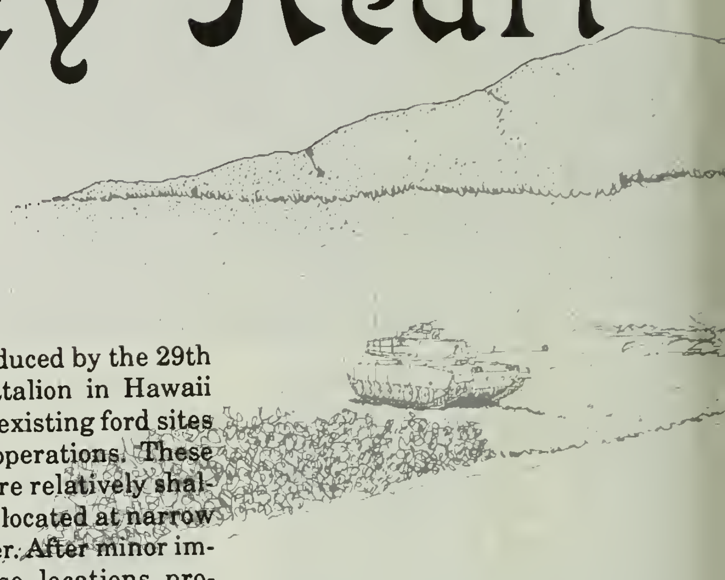
Once most of the contaminates are removed, microbes are introduced to the site. Under oxygenated conditions, these aerobic bacteria feed on hydrocarbons. Although they are naturally occurring to depths of several thousand feet, they do not normally get enough oxygen to consume significant amounts of petroleum. But when used for in sutu treatment, these microbes are supplied with oxygen, nitrogen and phosphates from injection wells installed on the site.

The effectiveness and speed of the treatment depends on the permeability and moisture content of the soil. This technique provides a permanent solution to the problem, but it's comparatively slow, requiring months or even years to complete. It's also expensive, though in some cases the cost can be comparable to incineration.

The Army's experience with underground storage tanks has been unhappy and expensive. We are gradually eliminating USTs completely, unless real and compelling necessity dictates their placement in the ground. And from now on, tanks that are put in the ground will have state-of-the-art construction with electronic monitoring for leaks. Though we must work under the burden of decades of past national ignorance of environmental concerns, we are learning fast—and making progress.

Mr. Murrell is chief of the Environmental and Natural Resources Branch for Fort Wood's DEH. He previously served as a mechanical design engineer for DEH. He holds a bachelor of science degree in mechanical engineering from the University of Missouri at Rolla.

Operation Cross My Heart



By Major Thomas J. Kelly

For engineers, getting mechanized maneuver forces across rivers is one of the riskiest—and most rewarding—missions around. Aside from being at the head of an advancing attack force (and bearing a good portion of the enemy's ire), engineers must overcome unpredictable rivers, too little bridging for the number of missions, and less-than-desirable crossing sites dictated by tactical necessity.

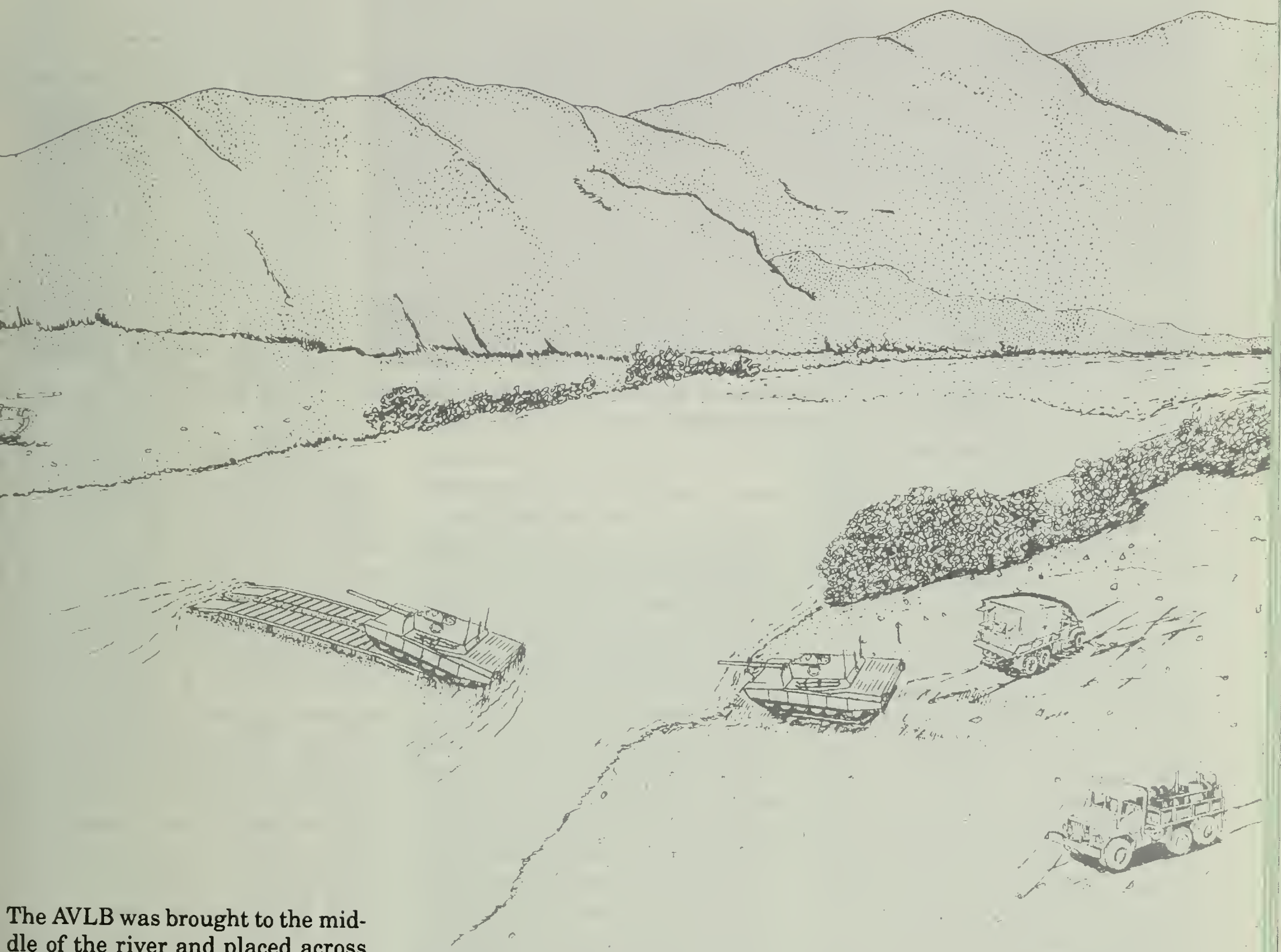
During Team Spirit 1990, the 44th Engineer Battalion, in Operation Cross My Heart, crossed three brigades of the 2nd Infantry Division over the Nam Han River in the Republic of Korea. The operation provided the battalion with a number of training and operational lessons that might be valuable to other engineer units—principally in ford site selection and construction.

Several important considerations need to be taken into account when selecting fording sites. Obviously, the first is the potential site's width and depth. This directly impacts on speed of construction—a critical factor in almost all tactical crossings. We were able to obtain maps produced by the 29th Topographic Battalion in Hawaii that detailed all existing ford sites in our area of operations. These existing sites were relatively shallow, and usually located at narrow points in the river. After minor improvement, these locations provided the quickest option for river crossing sites.

Fluctuations in river levels can play havoc with ford construction. In the case of the Nam Han River, we were at work on several crossing sites when a dam was opened upstream to release excess accumulated water. As the water level went up, and the current speed increased, it became impossible to continue construction. While operations were halted, we stockpiled borrow material at each site. Once the water level went back down, we were able to make up for lost time by quickly placing the stored material into the water.

The speed and route of river currents are also crucial. For successful ford construction, the current must be less than 3.5 meters (m) per second. Anything greater than this, and the ford will suffer rapid erosion. Depending on the location of the strongest currents, a straight-line ford may not always be the best choice. In fact, one of the fords put in by our D Company was curved. At this particular site, the presence of large rocks in the stream and their potential use in ford construction led to the curved design.

A rapid current may also cause gaps in an otherwise fordable site. High current speed will then prevent repair of the gaps, with fill material being swept away as fast as it's dumped in. In building one of their fording sites, B Company encountered just such a situation. The middle of the ford kept washing away, but there were no tactically-suitable alternatives available. Gabbeons made of chicken wire and large rocks were considered as a possible solution, but we ended up using an AVLB (armored vehicle-launched bridge).



The AVLB was brought to the middle of the river and placed across the gap in the ford. With the AVLB in place, the ford was passable for both tracked and wheeled vehicles.

Tactical suitability is the key consideration in fording site selection. The site must support the maneuver commander's operational scheme. Unfortunately, the rugged, compartmentalized Korean terrain doesn't allow many easy choices. Many sites chosen by maneuver commanders for their tactical advantage were not ideal choices in terms of engineering considerations. However, we made the best of the selected sites, as in the case of B Company's "AVLB ford." Needless to say, there should be close coordination between supporting engineers and the maneuver commander and his staff. While this will not eliminate technically awkward fording sites, an engineer who accompanies the maneuver commander on his ground recon and participates in operational planning will often be able to offer perfectly suitable alternatives.

Material availability should also be considered when planning or conducting ford construction. We found that for the Nam Han River, we needed river run material in about a 6-inch grade. The location of this material in relation to the ford site affected the type and number of vehicles needed to haul it. This, in turn, affected the speed of construction and the availability of equipment for other sites.

When swift currents kept washing out the center section of a ford, the battalion's Bravo Company used an armored vehicle launched bridge (AVLB) to complete their mission (U.S. Army photo).

Using a dozer/scraper team was the fastest technique for ford construction. At least two dozers were on each team; one with a winch to pull out mired vehicles. We also tried to have as many scrapers as possible on the site. The technique called for using the scrapers to haul in borrow material and stockpile it at the entrance to the ford. The dozer team would then push the material out into the river. Once the dozers had built the foundation of the ford across the river, the scrapers no longer stockpiled, but spread fill directly on the ford. For the scrapers to do this, the water had to be no higher than the center of the 621B scraper's tires (about 36 inches).

After the scrapers started depositing material directly on the ford, the speed of construction increased dramatically. The scrapers could usually pick up material on both banks of the river, allowing them to build up the ford each time they crossed the water. Sometimes the water was shallow enough to begin this process right away. We always checked ford sites with a dozer, testing the water depth as the dozer made its way across the river. If the river was less than 3 feet deep, the scrapers were put to work right away.

The other technique we used was the dozer/dump truck/scoop loader team. This worked best when the nearest borrow site was more than two kilometers away, or when scrapers were not available. This method is basically the same as the dozer/scraper team, but material is hauled by dump trucks filled by scoop loaders at the borrow site. This method works, but it's slow and requires more equipment. When using this technique, I recommend against the use of 20-ton dump trucks because of stability problems (they tend to tip over in rough terrain). Five-ton dumps are better because of their rough terrain capabilities. On the flip side, of course, they can't haul as much fill.

Marking kits for the fords were prepared well in advance of our arrival at the sites. Each kit marks 200 meters of ford, and consists of 8-foot U-shaped pickets, engineer tape, and chemlights. The pickets were placed 10 to 20 meters apart on both sides of the ford, with the concave side of the picket facing the friendly shore. A 6-inch chemlight was then placed in the concave side of each picket. We also tied white engineer tape around each picket to help highlight it. Initially, we tried stringing engineer tape between the pickets in the river. But the tape quickly became wet and heavy, and had a tendency to pull down the pickets (we were never able to anchor these pickets securely to the river bottom). Marking these fords is much like marking a lane through a minefield, and we executed them like battle drills.

One of the most valuable lessons we learned during the exercise was how to best care for equipment used in the water. Water contamination of lubricating fluids and air filters was our biggest headache. The most seriously affected were transmissions and differentials on the 621B scrapers. As the scrapers moved through the river, water splashed between the tractor and the pan. Water then entered the breather tubes that vented the transmission. Early in the exercise, we had to take a number of scrapers off the job to replace the contaminated fluids. We quickly went through all of our on-hand stock of fluids, and had to send back to our home base for more. The 16-hour round trip caused significant down-time for the scrapers.

To help alleviate the problem, one of our maintenance warrant officers developed a scraper modification that extended the length of the breather tube about two feet. This gave us pretty good insurance that water would not enter the tube. Even with the modification, we had to carefully monitor the scrapers for water contamination, checking them about four times a day.

We also had a problem with dozers and scrapers moving too fast in the water. This caused water to splash into the air filter housing intake and soak the filter. Operators checked the air filters regularly during operations. If a wet filter was caught soon enough, we could wipe out the housing and air dry the filter. If it stayed wet too long, we had to substitute a new filter. This quickly expended our available supply of filters.

The water contamination problem with the scrapers and dozers drove home the need to ensure extra POL and filter packages for equipment that was expected to operate in water for any length of time. I recommend stocking at least two changes of transmission and differential oil, along with two air filters, for each vehicle that will be over water (including dump trucks). Even if water contamination was not detected during operations, we felt it was necessary to change all fluids and air filters after fording activities were concluded. So be sure to take along at least one change of engine oil for each vehicle as well.

Several safety procedures need to be observed during fording operations. All operators and supervisors must wear life vests when they are over water. When working at night, operators need to have chemlights in their helmets so they can be seen if they fall into the water. If the river is fast and deep, it's wise to string a safety line downstream from the construction site. Soldiers who might fall in the water then have something to grab onto before they are swept away.

One of our companies also recommended tying scraper doors open so if a scraper overturns, the operator can quickly escape from the cab. It's also a wise precaution to have a safety NCO with the sole responsibility of watching for unsafe acts or conditions. In addition, we placed supervisors with signal flags on each side of the ford to safely pace crossing traffic.

Team Spirit provided the 44th Engineers (the "Broken Heart" battalion) with some valuable training experience in fording operations. And while we took some lessons learned home with us, the success of moving three brigades across a Korean river gave us that rewarding sense of accomplishment that I mentioned earlier.

Major Kelly is executive officer of the 44th Engineer Battalion. During Team Spirit 90, he served as the battalion's S-3. Previous assignments include engineer group S-2, engineer group assistant S-3, battalion S-4, and company commander. He is a graduate of Command and General Staff College, and holds a masters degree in robotics from Carnegie Mellon University. He is a registered professional engineer in Virginia.

(Personal Viewpoint, continued)

full-time staff in theater to perform special studies and assessments.

Army brigades and Navy COMCBLANT will provide regional planning support and region/country expertise, and perform preliminary project planning.

USACE South Atlantic Division will provide technical support and life-cycle program management. The Corps will conduct institution improvement programs, function as DOD construction agent, and maintain a full-time staff element in theater.

USAF Engineering and Services Center will provide technical support, conduct institution development programs, and provide staff augmentation as required.

This program applies CAPSTONE program concepts to theaters and regions for which CAPSTONE was not designed or appropriate. It addresses CINC requirements during peacetime and operations short of war. The same organizations can be used for low-, mid-, and high-intensity conflicts in any theater. Success in this program, however, is likely to prevent such conflicts by alleviating economic problems within host nations.

The mission will be given to flag headquarters in addition to their CAPSTONE affiliation. This will allow headquarters to tailor the support they provide. Individuals will stay under the command and control of their parent unit but will work for and within the joint arena. No changes in the functions performed by headquarters now in place are anticipated in planning, preparing, and executing the program.

End Results

The economic benefits are many. By combining expertise from many agencies and coordinating planning, we will eliminate duplication and locate developments where they will most benefit host nations. U.S. ambassadors will play a major role to ensure America receives a maximum return for every dollar spent.

And, the program works. The 412th Engineer Command, headquartered in Vicksburg, Mississippi, is successfully working under this concept. In conjunction with CINC, SOUTHCOM, the 412th is planning nation assistance activities that are integral parts of the CINC's counternarcotics campaign plan and the ambassador's country plans.

The United States must work to prevent conflicts in developing nations. We must help them develop an infrastructure that will improve their citizens' lives. At the same time, our units will receive valuable training. It is a true win/win situation. Let us support this joint service concept!

General Schulz, commander of the 412th ENCOM since November 1986, assumed command of the 377th Theater Army Area Command in May 1991. He has worked on war planning in Europe for 14 years and with engineer deployments in Central and South America since 1981.

Engineer Problem

ASSAULT BREACH

This is the third of four engineer problems dealing with breaching operations. The problems reflect concepts outlined in FM 90-13-1, Combined Arms Breaching Operations, *which was distributed in February 1991. Previous problems dealt with in-stride and deliberate breaching operations. This problem focuses on an assault breach.*

The scenario depicted in each problem illustrates specific teaching points on that type of breach. An excerpt from FM 90-13-1 describes the characteristics of the breach and when it will be used. The problem-solving process is presented using the engineer estimate process and includes some key discussion points.

Problem: As the task force (TF) engineer of a light/heavy task force and the engineer platoon leader, you are to recommend a task organization of engineer assets to the TF commander.

Mission: You are the platoon leader of 1st Platoon, Company C, 21st Engineer Battalion (1/C/21 EN BN), which is attached to TF Steel. The task force's mission is to secure a section of Highway One, from its intersection with Highway Two to the bridge over the Blue River (Figure 1). Control of this highway will allow follow-on heavy forces access to Highway Two and deny the enemy a supply route over the river.

Situation: TF Steel has one light infantry battalion, one company of M1A1 tanks (equipped with three mine plows and one mine roller), two stinger teams, and your engineer platoon.

Hill 165 (Figure 1) is the dominant terrain feature in TF Steel's zone. Thick forest and dense underbrush prohibit vehicular movement through most of the sector. The enemy is dug in on Hill 165 in company strength. Another enemy company is dug in near the intersection of Highway One and Highway Two. One enemy squad is guarding the bridge over the Blue River. The enemy is armed with assault rifles, medium machine guns, rocket-propelled grenades (RPG), and Sagger anti-armor missiles. They can also call upon indirect fire from mortars and artillery. Enemy artillery is capable of delivering scatterable mines.

One of your engineer squads has completed a reconnaissance of enemy obstacles. The squad leader reports that the only bridge over Green Creek has been destroyed; a bypass just west of the bridge is the only site where vehicles can cross the creek. An anti-tank point minefield followed by an abatis, located north of the bridge on Highway Two, can also be bypassed.

The position on Hill 165 has an anti-personnel (AP) minefield located from 25 to 75 meters in front the fighting positions. This minefield is about 25 to 35 meters wide and consists of surface-laid mines with trip wires. The squad leader is certain there are some M16A1 AP mines, but he does not recognize the

Engineer Problem

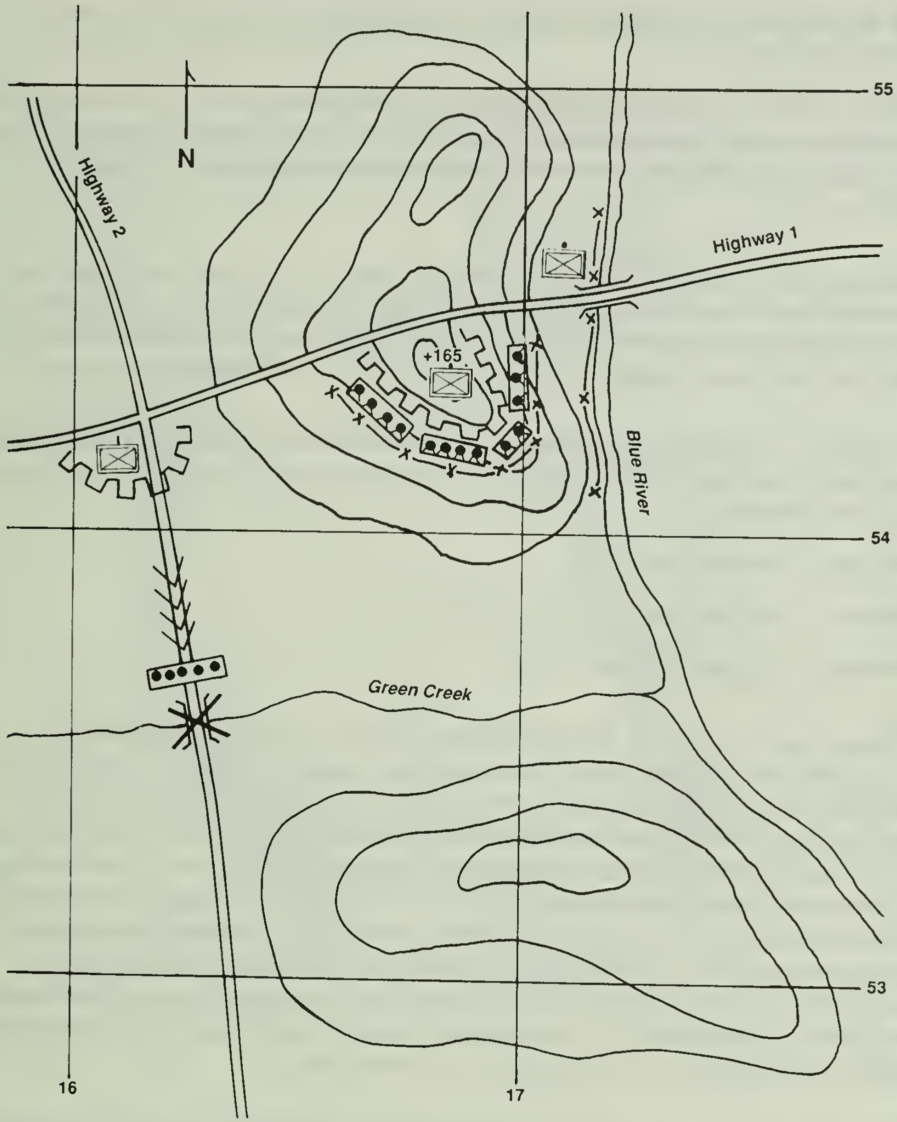


Figure 1. Situation Template

others. They are shaped somewhat like an M16A1 AP mine, but have a half-dome with one pin sticking straight up out of the top. Four other pins stick out of the canister in various directions. The squad leader does not know if other mines are buried in the minefield—he could not detect any obvious signs of buried mines.

A concertina fence near the edge of the minefield consists of two rolls of concertina stacked one on the other. The rolls are held in place by metal pickets. The fence is anchored with barbed wire strung over the top concertina roll and staked in the ground with wooden tent pins. A 4-strand barbed wire cattle fence stands

Engineer Problem

at the far edge of the minefield. Most of it is strung around trees, but some is strung on pickets.

Along the bank of the Blue River is a large concertina fence. It consists of eight rows of concertina that are stacked three high and held in place by pickets. There are no gaps between the rows, and the squad leader detected no break in the fence.

Commander's Intent: "The key is Hill 165 (OBJ TOP). We must move quickly and violently to secure the hill. OBJ X-RAY, near the intersection of Highways 1 and 2, cannot be taken until we occupy OBJ TOP. I would like to take the bridge intact, but I am more interested in securing OBJ TOP as quickly as possible."

Execution: The task force commander selects the scheme of maneuver shown on the Task Force Operations Overlay (Figure 2, page 35). The operation will consist of three phases:

Phase 1 - Secure OBJ TOP

Phase 2 - Secure OBJ X-RAY and OBJ AXE

Phase 3 - Secure OBJ HATCHET

Phase One: Team Tank, which includes one tank company, one infantry platoon, and the battalion TOW (tube launched, optically tracked, wire guided) missile will occupy attack by fire (ABF) position 1, oriented on Hill 165 (OBJ TOP). Division artillery assets will provide preparatory fire on OBJ TOP, and battalion mortars will fire smoke to obscure the assault. Companies A and B will attack in echelon along Axis Right to OBJ TOP. Company A is tasked to breach footpaths through the protective obstacles and to gain a foothold in the enemy entrenchments (OBJ TOP). Company B will then pass through Company A, secure OBJ TOP, and occupy ABF 2, which is oriented near the road intersection (OBJ X-RAY). Company C (-), the battalion reserve, will prepare to assume the missions of Company A or Company B, as necessary.

Phase Two: As soon as Company B has occupied ABF 2, Team Tank will attack along Axis Left and secure OBJ X-RAY. On order, Company A will secure the bridge (OBJ AXE).

Phase Three: After OBJ X-RAY is secured, Companies B and C will occupy OBJ HATCHET, and the task force will prepare to pass follow-on forces to the north.

The commander of Company A informs you that he plans to assault OBJ TOP with two infantry platoons. The TF commander then asks you to recommend an engineer task organization to support this mission.

Engineer Problem

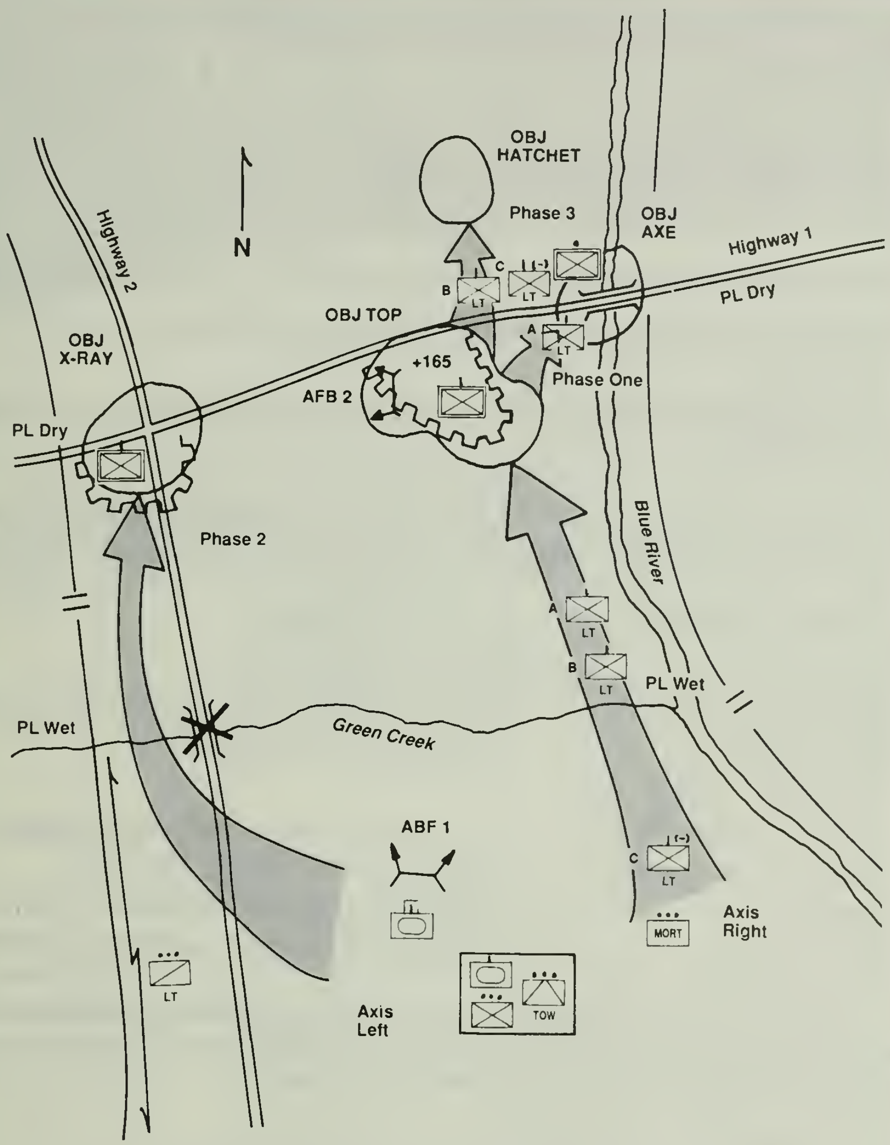


Figure 2. Task Force Operations Overlay

ASSAULT BREACH DESCRIPTION

Definition: A unit conducts an assault breach during the penetration and destruction phases of action on the objective, when the mission requires destruction of an enemy that may have emplaced protective obstacles.

The commander uses an assault breach to break a dismounted force through enemy protective obstacles to the enemy position. The assault breaching procedure may be a variation of either deliberate or in-stride breaching techniques.

Engineer Problem

The type of procedure used depends on the size and complexity of the defensive obstacle system.

Characteristics.

The commander uses an assault breach for—

- ▶Small unit actions (squad or platoon teamwork)
- ▶Actions when enemy small-arms fire is the primary threat to be suppressed
- ▶Obstacle reduction when breaching a footpath that has few if any assault markings
- ▶Extremely decentralized fights; breach efforts will be synchronized by small unit leaders

Problem Solving Process: The engineer estimate, an integrated extension of the command estimate, is conducted concurrently with other staff estimates.

Command Estimate	Engineer Estimate
Mission	*Engineer mission*
Facts and assumptions	*IPB and engineer battlefield assessment (EBA)*
Mission analysis	*Engineer mission analysis*
Commander's guidance	- - - - -
Develop courses of action	*Develop a scheme of engineer operations*
Analyze courses of action	*Wargame and refine engineer plan*
Decision	*Recommend a course of action*
Action and orders	*Prepare final engineer plan and issue orders*

You have enough information to start developing a scheme of engineer operations. Use essentially the same steps the commander used to develop courses of action to develop the scheme of engineer operations.

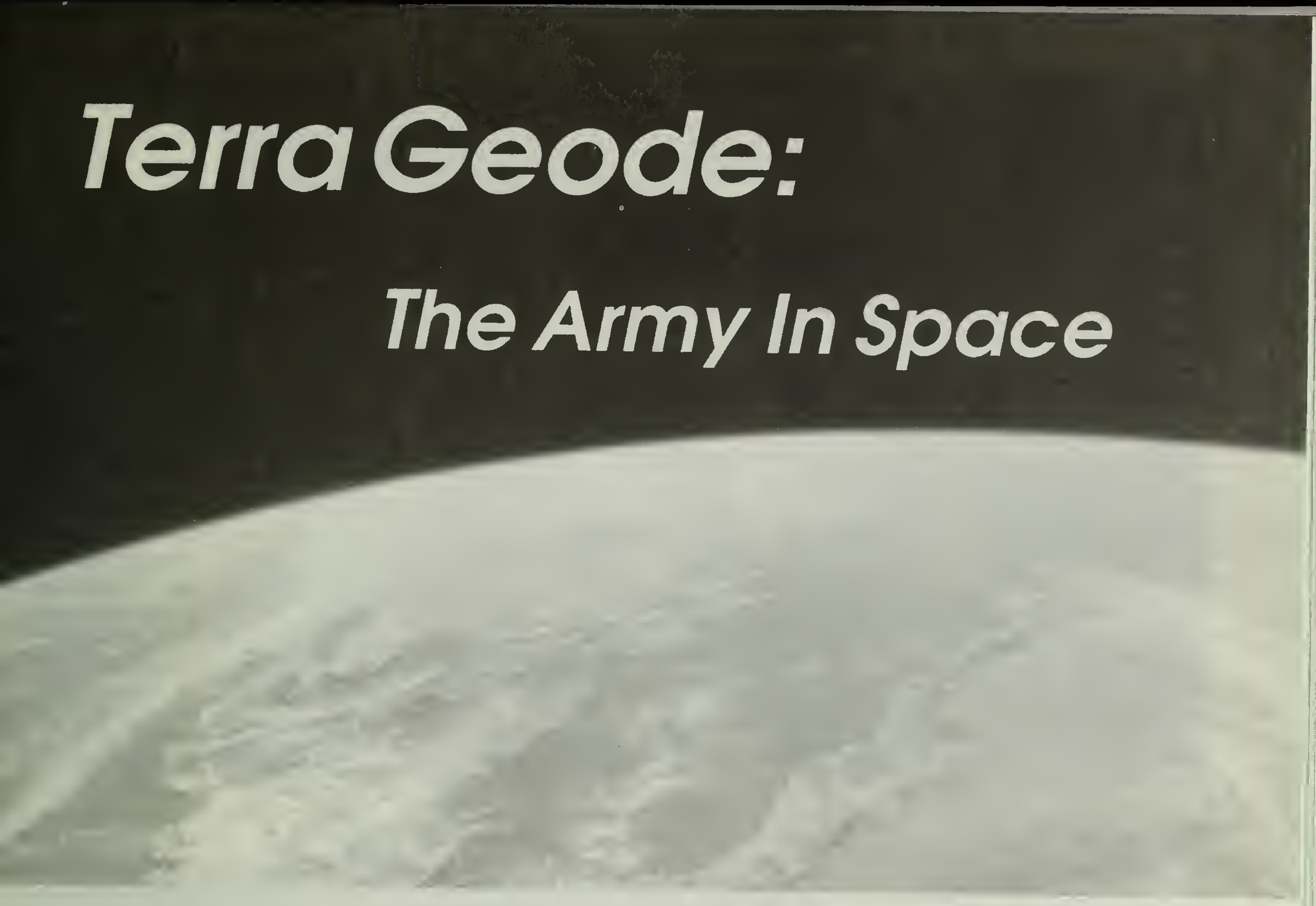
1. Analyze relative combat power
2. Identify engineer battlefield missions and allocate forces
3. Develop a scheme of engineer operations
4. Balance force allocation with available assets
5. Integrate decisions into the maneuver course of action sketch

After developing a scheme of engineer operations, the next step in the engineer estimate is to wargame and refine the engineer plan. Once completed, this step should provide a recommended course of action.

Engineer Solution begins on page 45.

Terra Geode:

The Army In Space



By Captain John Karpiscak III

The modern battlefield, as so vividly illustrated during the Gulf War, is dominated by high-tech, well-trained forces who can strike the enemy at will throughout the theater of operations. To assist ground commanders in determining terrain conditions and enemy disposition, the Army Corps of Engineers has initiated its Terra Geode space program.

Terra Geode is an experimental program designed to determine the value of having a soldier in space who can make military mobility predictions from Earth orbit. It's one of a series of experiments sponsored by the Department of Defense (DOD) to conduct space-related military experiments from Earth orbit. The Army, Navy, and Air Force all have ongoing or planned space experiments falling under the Military Man in Space (MMIS) program. MMIS covers defense-related experiments involving direct military astronaut participation, and experiments that have a military application but do not require the presence of a military astronaut.

Why is the Army involved in space when many people say its attention would be better focused on the ground? Simply put, the Army is reaching into space precisely because it has an increasingly complex and demanding job on the ground.

Time and world events are reshaping modern warfare. A shrinking force structure that's transitioning from a deployed to a deployable force, and increasing emphasis on non-linear warfare will mean a greater need to assess enemy strengths, intents, terrain, and movements. The Army's use of space will help us do just that. It is out of this need for rapid information gathering and analysis that Terra Geode came about.

The experiment began in 1986 when the Chief of Engineers proposed a program to provide terrain and geomorphological analysis from Earth orbit. Designed to provide near-real time battlefield perspective for maneuver commanders, the Terra Geode concept is well on its way to becoming reality.

Terra Geode is organized into four phases, with the first two already completed. The first involved basic terrain observations by military astronauts. The next phase include terrain

Dr. Kathy Sullivan, the only trained geologist on the NASA astronaut staff, makes observations of the earth's surface during a space shuttle flight (NASA photo).

observations by an astronaut with a background in geology.

The third phase will call for a synthesis of the talent found in the first two phases: an astronaut who has both the scientific/geologic background to recognize terrain features, and the military background to translate the terrain observations into military operational considerations and terminology.

The final phase of the experiment will see an Army payload specialist making observations of the Earth while stationed aboard a continuously-manned platform.

In 1988, the Engineer School accepted responsibility for the project, now overseen by the school's Directorate of Combat Developments. A year later, Army personnel were invited to apply for the position of Terra Geode payload specialist. Four highly qualified soldiers would be chosen. One would be the payload specialist, the person who would conduct the Terra Geode experiment in orbit. Another would be a backup, fully capable of conducting the experiment should something happen to the primary. Two other persons would serve as alternates; qualified for flight but not involved in training with the crew or development of the experiment.

By January 1990, 21 military personnel had applied for the positions. After an initial qualification scrub, the field was narrowed down to eight. Two later withdrew from consideration for medical reasons. In June 1990, the remaining six were interviewed at Fort Leonard Wood by a panel of engineer officers, and the final four were selected.

Man vs. Machine

In discussing observations of geological forms from Earth orbit, an argument can be made that there is no need for a manned presence in space. It has been said that unmanned assets, such as remote sensing satellites, are available for conducting such missions. However, in observing the Earth from orbit, it turns out that the human eye has a greater visual range capability than remote sensors.

Man's unique advantage over orbiting sensors is his ability to not only gather raw information, but to instantaneously evaluate the situation. Sensors may provide follow-on supporting information. However, it's important for the human eye to take the first cut at Earth observations.

The National Aeronautics and Space Administration (NASA) noted the limitations of remote sensing when it wrote "...fixed automated sensors...do not have the capabilities of human observers in space to search for (in this case), sources of moving sand or to relate evidence of eolian transport to changes on the land surface." NASA went on to say that "A human observer in space has the unique capability to take high-oblique photographs and stereo-photographs and to select areas to photograph with a telephoto lens. This capability should be used to the fullest extent in future missions."

With regard to geological

observations, NASA has also said that "The great value of photographs is in the effective selection of a view of the subject in which lighting and camera position, as well as other transient conditions, permit the geologically significant aspects of the subject to be photographed. This requires a value judgement on the part of the operator of the hand-held camera, which distinguishes his work from mapping-camera photography. There is a tendency to view geological subject material as static and therefore automatically capturable. This is erroneous. Informative photographs of geological features are the result of an educated photographer recognizing an effective opportunity."

Another unique advantage of manned observation from earth orbit is a human's ability to shift his field of view—tightening and widening his area of focus—to concentrate on areas of current interest.

Unlike a machine, a human also has the ability to discriminate or filter out unneeded data while making evaluations. He can make more subtle color distinctions and comparisons than are possible by machine. Too, the human being can take advantage of exploring and exploiting other opportunities, interpreting previously documented but hitherto unexplained phenomena. The human eye also has a greater 'dynamic range' for detecting light in the visible spectrum than either color film or orbiting instrumentation.

Eye vs. Camera

As an example of this, William Pogue, a former Skylab astronaut, along with the rest of his crew, noted with disappointment at his post-mission debriefing, that the pictures of earth taken from orbit looked 'washed-out', and did not record the details of texture and hue that were visible to the naked eye. Pogue explained that "the tone sensitivity of the color film emulsion was inadequate." Pogue went on to say that, in some cases, items clearly visible to the eye didn't even show up in the pictures, although properly exposed film was used.

Pogue also noted that the eye-brain system has the ability to probe, or see through partially opaque layers of clouds such as haze, scattered light clouds, aerosols or thin clouds. After filtering out the opaque, the brain reassembles the partially obscured image into one that provides a more complete picture than would be available to a camera. This is similar to looking through blinds or an insect screen in a window out at the ground below. The brain "restores" the tiny missing pieces of the picture, and gives the viewer the impression of a complete image.

Soviet views on the subject are similar. Jim Oberg, in his book, *Pioneering Space*, cites Vladimir Lyakhov, a veteran of almost an entire year of orbiting the planet on two flights, as stating that "No form of optics can replace the human eye."

Recognition of patterns, shapes, sizes and textures are other qualities that enable man to transcend the abilities of machines. While film is able to discriminate better with respect to size, the human eye is vastly superior when it comes to the color and tone of an object.

It is virtually impossible for a remote sensor to observe and discriminate between patterns on the Earth's surface. For example, it's been demonstrated aboard the Skylab orbiting workshop that the

A photo of the Lake of the Ozarks area of central Missouri, taken during a space shuttle flight (NASA photo).

A satellite photo of the Libyan chemical weapons facility. Army astronauts, with both tactical experience and geological training, could be invaluable to military planners when observing such potential targets (EOSAT photo).

human eye is far superior to a remote sensor in its ability to distinguish between snow, ice, and cloud formations.

The human is also able to take advantage of opportunities that are beyond the capabilities of automated sensors. For instance, waiting for the right time (lighting, cloud cover, etc.), to accentuate a particular feature for photographic purposes. By the same token, the human is able to recognize differing geographical and geological areas under a wide variety of light and perspective conditions. Features such as ice and snow, sand dune formations, along with atmospheric disturbances such as dust storms, fire, and haze are some of the things more easily distinguished by the human eye than by machine.

Again, NASA has stated that previous space crews "were able to observe selected areas, taking full advantage of changing solar illumination (Sun elevation and azimuth); varying degrees of obliqueness, and shifts in line-of-sight azimuth. Geologically, this target-of-opportunity capability is very useful because one particular combination of viewing angle and illumination may provide the key to recognizing new features in well-mapped terrain."

A benefit that will never be surpassed by machine (with the possible exception of a highly advanced, artificial intelligence system), is man's ability to adapt. Man has the ability to react to a changing environment and take advantage of unforeseen and unpredictable opportunities by restructuring standing instructions and protocols. Views of eruptions, fires, storms, and storm damage, once detected, would take long periods of time to program into an orbiting automated sensor and an almost equal length of time to process into an acceptable image. A human in orbit would be able to analyze the situation instantly.

Geology and the Military

The concept of predicting military mobility from space faces an unusual challenge. While we tout the capabilities of manned observation, there is only one trained geologist on the NASA astronaut staff: Dr. Kathy Sullivan. Herein lies a dilemma. We have military astronauts, some with ground combat experience, but none with backgrounds in geology. Conversely, we have one geologist astronaut who has no ground combat experience.

Terra Geode will provide the Army with a payload specialist who has the geology and terrain analysis training, as well as the military expertise necessary to make mobility predictions from low Earth orbit.

Military experience is a prime requirement for the Terra Geode payload specialist. While a geologist may be able to answer some basic questions about terrain analysis, more involved terrain questions—and certainly mobility predictions—require experience beyond classroom instruction. And qualifying military experience is acquired only after a comprehensive tour of duty in line units.

To illustrate, if a non-military astronaut were to try to obtain sufficient military experience by participating in exercises such as REFORGER, he or she would get an appreciation for only one particular type of Army operation. The scenario would include a handful of basic military unit types, and would be conducted in a single operating environment. While such experience would be helpful, it would be so narrow as to create the false impression that this is the standard (or only) way that the Army conducts operations. This could lead to misleading or erroneous conclusions in assessing and making mobility predictions for the terrain being observed.

Astronauts (or mission specialists) are charged with piloting shuttle and other spacecraft, and don't have the time to be sufficiently trained in military operations. It's vital that this experiment be conducted by a military payload specialist with broad-based field operations experience and a geological background.

Maps

In addition to the inherent problems of using remote sensors for terrain observation, maps used for military operations also have their limitations. The Defense Mapping Agency, contrary to popular belief, does not have the entire surface of the Earth mapped at either the strategic (1:1,000,000) or operational (1:500,000) levels. At the tactical level (1:50,000), only 6 percent of the Earth has been mapped.

A look at recent history is telling. In his book, *Urgent Fury: The Battle for Grenada*, Major Mark Adkin, a retired British officer, wrote that "Perhaps the most serious handicap, aside from the conspicuous lack of good intelligence on all aspects of the operation, was that nobody had a map. To plan a military operation without a map is a sure way of ensuring participants are confused and unclear about their objectives."

Additionally, the information that some maps carry is inaccurate or out of date. This may lead to poor mobility predictions regarding threat movements. A recurring reason for many military failures has been the inability to predict the movements of an enemy force, or to have underestimated its mobility. For example, when a commander looks at dune patterns on a 1:500,000 scale map, he must decide if the patterns are current, or if they have shifted since the map was produced. Do the maps indicate a continuous sand floor, or exposed bedrock between the dunes? How old are the maps that are being used in this area, and what data was used to construct them? Looking at dense forest terrain, can it be determined if the area you are looking at is thick South American rain forest, or has the area been a recent victim of slash-and-burn clearing activity? All of these questions are important to a terrain analyst, and Terra Geode is expected to help address them.

Things to Come

None of this information is new. What have been described are proven techniques and capabilities that have apparently been set aside or forgotten over time with the advent of (or perhaps preoccupation with) newer, more sophisticated remote sensors.

But scientists and astronauts have recommended that a well-designed Earth observatory be put into orbit to monitor both the sunlit and dark sides of the Earth. Such a facility would be equipped with manual pointing capabilities, surface feature automatic tracking, zoom optics, field-of-view alpha-numeric displays, time tagging of verbal comments and data, and film/video recording of active viewing sequences. These are all features we envision being used during Terra Geode Phase IV.

Gerald Carr, a Skylab IV astronaut, wrote "I think that we have discovered a new national resource. With better equipment and more sophisticated training, space observers can capitalize on their initiative, discrimination, and judgement to obtain information to better understand and manage our environment and to conduct Earth science experiments from space."

While much has been accomplished on the Terra Geode project, a lot of work remains. As yet, there is no firm timeline on the program, and full NASA acceptance and subsequent completion of the program will likely depend on competing projects, projected launch schedules, and funding.

But when Terra Geode reaches its goal, it will give the Army an unprecedented advantage in military mobility predictions—an advantage that cannot be attained by machines alone.

Captain Karpiscak is the space officer for the Engineer School's Directorate of Combat Developments. He previously served as commander of HHC, 1st Engineer Brigade. Other assignments include battalion S-1, DEH staff officer, commander of 95th Engineer Detachment, combat engineer platoon leader, and vertical construction platoon leader. He holds a degree in architecture from Kansas State University, and a masters degree in business administration from Rider College.

LESSONS LEARNED

Tactical Lane Marking Procedures

By Captain Martin B. Dorey

Engineer doctrine for marking tactical lanes during combined arms breaching operations changes frequently. To help you cope with the changes, we have gathered the following information from observations made at the National Training Center, REFORGER, and Operation Desert Storm. Use this information to help develop or improve the field standard operating procedure (FSOP) on breaching operations for your unit.

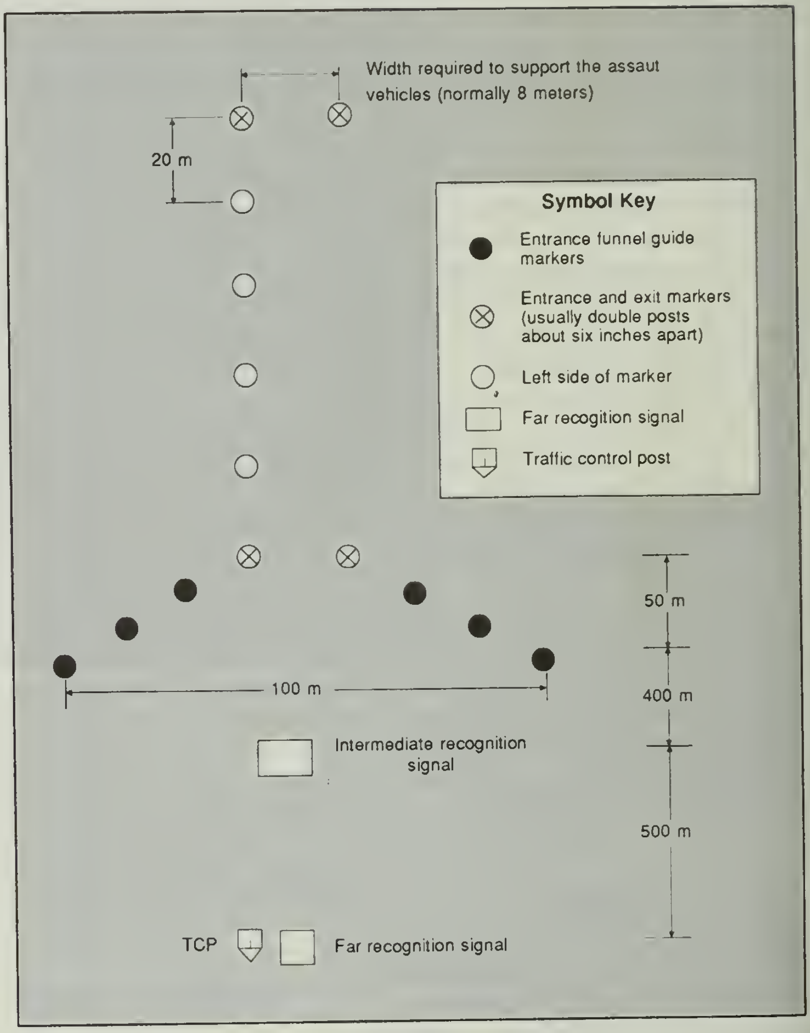
Tactical Lane Marking. The breach force has initial responsibility to mark a tactical lane. After the breach is completed, the breach force commander reports it to higher headquarters. On order, breach force engineers then begin to tactically mark the lane, as described in FM 5-71-100.

Tactical lane markings must be easily seen and recognized by crews in buttoned-up vehicles. The breach force must mark a breach lane at the entrance, along the left side, and at the exit.

Entrance Markings. Entrance markings must be easily distinguished from all other lane markings. Establish a funnel-shaped entrance and spread it over a 100-by-50 meter rectangular area. The funnel shape provides an opening that narrows in width from 100 meters at the outer edge to 50 meters at the entrance to the tactical lane. This shape allows dispersed, mounted forces to transition to a column formation.

Establish far recognition markers to guide follow-on assault forces to the breach lane. Place these markers as far as 1 kilometer (line of site dependent) from the breach lanes. Place unmanned, intermediate recognition markers about 500 meters (line of site dependent) out from the obstacle.

Breach Lane Marking. Observations and experiences from the Combat Training Centers indicate that drivers of M1, M60, M2/3, and M113 series vehicles prefer left-hand rail markings on lanes. They find it difficult to remain on a centerline due to dust and smoke. To be clearly visible, drivers need markers that are at least 3 to 5 feet tall. These markers should be reusable. If possible, emplace left-side markers from an armored vehicle to protect the sappers or infantrymen from direct small arms or indirect fires.



Width required to support the assaut vehicles (normally 8 meters)
20 m
Symbol Key
● Entrance funnel guide markers
⊗ Entrance and exit markers (usually double posts about six inches apart)
○ Left side of marker
▭ Far recognition signal
Traffic control post
50 m
400 m
500 m
100 m
Intermediate recognition signal
TCP
Far recognition signal

Figure 1. Tactical lane marking system

Exit Marking. Like the entrance, the tactical lane exit must be clearly distinguishable. The driver and track commander must know when they are out of the lane and free to maneuver (Figure 1).

Use a standard tactical lane marking system throughout the division. The division engineer will

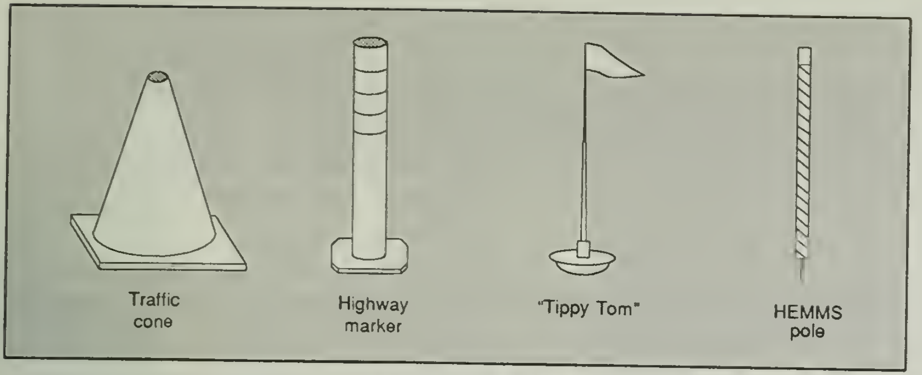


Figure 2. Currently available lane markers

determine which method to adopt.

Marking systems currently in the supply system are —

- Hand-Emplaced Minefield Marking System (HEMMS), NSN 9905-01-019-0140
- Minefield Marking Set #2, NSN 9905-00-375-9180
- CLAMS, NSN 2590-01-205-3082.

Nonstandard items that can be used include traffic cones, highway markers, and locally fabricated "Tippy Toms." A Tippy Tom, copied from an Israeli system, is made from a fabricated base and HEMMS poles (Figure 2).

Expanding Tactical Lane Marking. Up to this point we have discussed the minimum requirements for a tactical lane marking system. However, we also need a simple, workable system to improve the markings for expanded tactical lanes.

As a situation develops, regimental sappers will reduce the number of lanes and place markers on the right side of the breach lane. Engineers will place markers as far out as required to control traffic flow.

Engineers must widen the original breach lane, which is 4 meters wide, to accommodate two-way traffic. This high priority mission will expedite passage of divisional units and facilitate the evacuation of casualties from the front. After the widened lanes are proofed, engineers will establish a centerline and emplace an exit funnel marking system.

Prepare lanes to standard widths—8 meters for one-way traffic and 16 meters for two-way traffic. Install one-way traffic signs on each lane, for both directions, to assist traffic flow (Figure 3).

As the final step, follow-on corps combat engineer units expand and mark the breached lanes. The lanes are marked in accordance with procedures on page 67, Chapter 3, FM 20-32, using Standard Minefield Marking Set #2, (Figure 4, page 44). The final marking system must be standard throughout the corps.

The Engineer School is requesting information about effective methods of marking breach lanes. If your unit has developed an effective marking system, or if you have an idea you'd like us to explore, write to:

Commandant
U.S. Army Engineer School
ATTN: ATSE-ESA (Captain Dorey)
Fort Leonard Wood, Missouri 65473-6630

Include your name, address, unit, and telephone number.

References. The following references provide information about breaching obstacles:

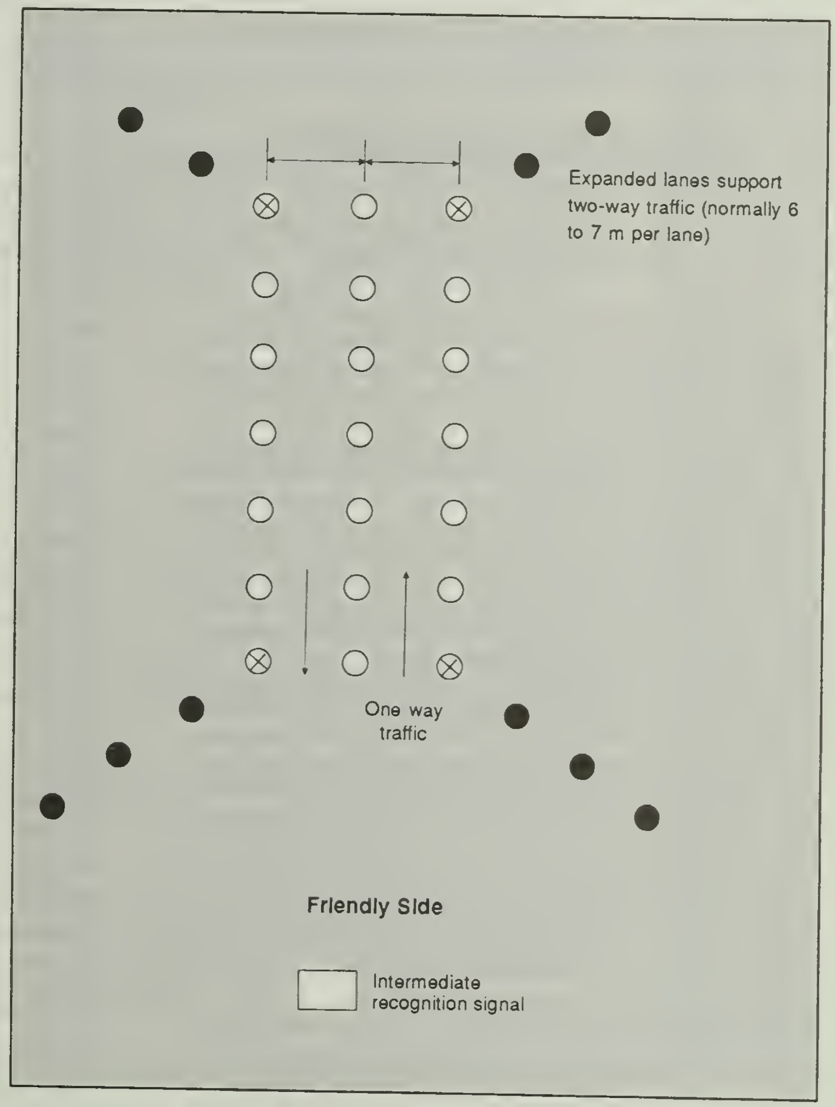

Expanded lanes support two-way traffic (normally 6 to 7 m per lane)
One way traffic
Friendly Side
Intermediate recognition signal

Figure 3. Expanded tactical lane marking system

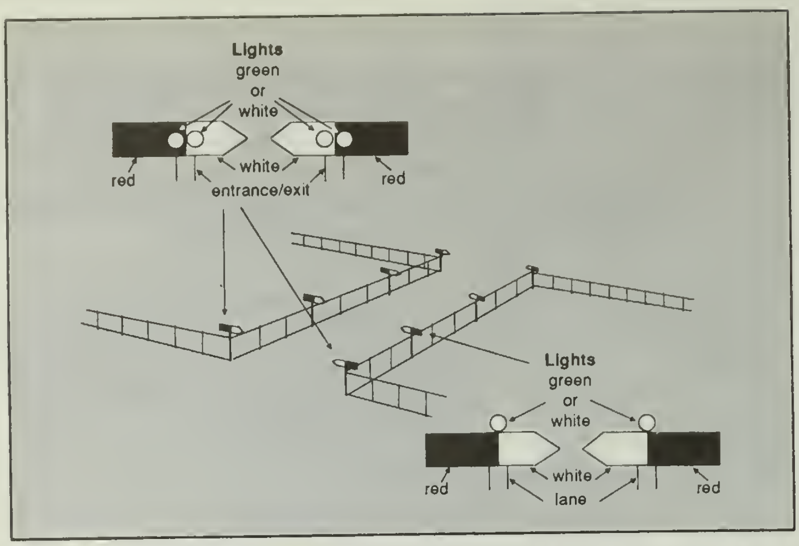


Figure 4. Marking lanes with Standard Minefield Marking Set #2

- FM 5-71-100, February 1991, (Coordinating Draft) *Regimental Engineer Combat Operations*
- FM 90-13-1, February 1991, *Combined Arms Breaching Operations*
- FM 20-32, December 1985 (under revision) *Mine/Countermine Operations*
- TM 5-9905-200-10, August 1979, *Operator's Manual; Minefield Marking Set, Hand Emplaceable, M133 (HEMMS)*
- TM 9-2590-508-10, July 1989, *Operator's Manual; Clear Lane Marking System (CLAMS)*
- REFORGER, National Training Center, and Operation Desert Storm observations (Lessons Learned)

Captain Dorey is an evaluation officer with the Directorate of Evaluation and Standardization, U.S. Army Engineer School. He previously served as brigade engineer, company commander and S4 with the 7th Engineer Battalion, 5th Infantry Division, and platoon leader and executive officer with the 58th Engineer Company, 11th Armored Cavalry Regiment. He is a graduate of the Engineer Officer Basic Course, Armored Officer Advanced Course, and the Combined Arms Services and Staff School.

Book Review

"The Forgotten War. America in Korea 1950-1953," by Clay Blair, 1136 pages, Anchor Books, New York, 1989.

Clay Blair is a former military correspondent for *Time* magazine and editor of *The Saturday Evening Post*. His best-selling study of the U.S. submarine war against Japan, "Silent Victory," established his reputation as a military historian.

Blair wrote this detailed history to tell about the Army's first year on the battlefield in Korea. This was an important war—its impact intensified the cold war, resulted in the arms race buildup, and fostered the idea that communism could be stopped by limited American power. This last idea ultimately led to US intervention in Vietnam.

The political background of the Truman administration set the stage for our intervention as a symbolic act rather than a threat to US vital interests. Once committed, the Army was set up for defeat before the fighting began. It was not prepared mentally, physically, or organizationally for war. The leadership generally was overaged, inexperienced (most had staff experience during World War II), and often incompetent.

Blair presents two human factors that affected the war: The representation of West Point graduates among the combat commanders, and the performance of black troops in combat. The reader concludes that true leadership in Korea came from professional officers in command of infantry regiments and battalions. The black units did not perform well in combat and, as a result, the entire Army desegregated in October 1951. In defense of the black soldiers, Blair reveals that some senior Army leaders were racist and many white officers who led black units were incompetent or cowardly.

The battle narrative is thoroughly presented through each phase of the war, from the sad and shameful retreat to the Pusan Perimeter, to the invasion of North Korea. Blair depicts the Army as poorly trained and ill-equipped, but with each passing battle and buildup of US divisions, it becomes battle hardened and successful when properly led.

The introduction of Chinese forces marks a major turning point. The United Nation (UN) Command's poor intelligence and underestimation of China's response were major strategic failures.

Much is written about the spell MacArthur had on the Joint Chiefs of Staff and the Administration. His push for expanding the war is seen as an attempt to save face for his failure as the Far East Commander, and in the process the Eighth Army was nearly destroyed.

Blair fairly portrays the history of the infantry in Korea. The US "drew the line" and UN forces stopped the communist aggression. It was the first test of UN forces, and the last true UN coalition until the recent Gulf War.

The performance of the US Army so shortly after the victory of World War II was disheartening to read. I was dismayed by the politics and power play by US senior military leaders. Battlefield leadership was absent or infrequent until LTG Ridgway arrived in December 1950. The book abounds with reports of cowardice and retreat on one hand, and heroics by small unit leaders on the other. The price we paid in lives for not properly preparing, training, and leading soldiers is a black mark on our Army's history. For this reason, the book must be read and studied by all leaders. We must never again go to war like we did in June 1950.

We partially learned our lessons from Korea in Vietnam. But like Korea, the nation tired of the war and did not acknowledge returning soldiers. In contrast, the success of the coalition forces in the Gulf War is in part a result of several factors: our learning the lessons of Korea (and Vietnam); never to go to war unprepared; never piecemeal the fight; develop a professional army and leadership corps; and have the commitment and support of the nation to the soldiers who fight.

By LTC Ralph Grieco, commander of the 31st Engineer Battalion, Fort Leonard Wood.

Engineer Solution

DEVELOP A SCHEME OF ENGINEER OPERATIONS

Step 1. ***Analyze relative combat power.*** The analysis of relative combat power is based on the Situation Template (Figure 1, page 33) and an assessment of enemy and friendly engineer capabilities. Use an engineer battlefield assessment (EBA) to determine these capabilities.

Enemy engineer capability. The terrain and vegetation from phase line (PL) Wet to PL Dry will prohibit vehicular movement except along Highway Two. Tanks can cross Green Creek only at the ford site, just west of the destroyed bridge. Extensive protective obstacles, including barbed wire and AP mines, are on OBJ TOP. These mines probably are well camouflaged, and some probably are equipped with anti-handling devices. The bridge across the Blue River may be rigged for demolition. The enemy is capable of delivering scatterable anti-tank (AT) and AP mines from artillery.

Friendly engineer capability. The mobility assets of the task force are emphasized in this problem. The attached tank company has one mine roller and three mine plows. Each of the nine infantry platoons is capable of limited breaching operations, and the task force is accustomed to integrating your three sapper squads when they conduct breaching operations.

Step 2. ***Identify engineer battlefield missions and allocate forces.*** Use the reverse planning process to identify engineer tasks from the objective back to the start of operations. Each time you identify an engineer mission, you must determine what resources are needed to accomplish it. The Engineer Working Overlay (Figure 3, page 46) shows the engineer missions identified and resources required to accomplish them.

Summary of engineer tasks:

Axis Left	Axis Right
1. Assist clearing bunkers on OBJ X-RAY. (one engineer team)	Clear bridge of demolitions. (one engineer platoon)
2. Breach potential scatterable minefield. (three mineplows, two engineer squads)	Assist in clearing bunkers on OBJ TOP. (three enginer teams)
3. Clear bypass of mines. (one engineer squad)	Breach one footpath per infantry platoon assaulting through the protective obstacles. (two engineer squads)

Remember, you must consider all engineer assets at the task force's disposal, not just those from your engineer unit. Remember that the resource estimates are unrestrained.

As you allocate resources, you realize there are not enough engineer assets on hand to successfully breach the potential obstacles on Axis Left. You bring this to the attention of the task force S-3. He requests an additional engineer platoon from the follow-on forces, but instructs you to complete the task organization on the

Engineer Solution

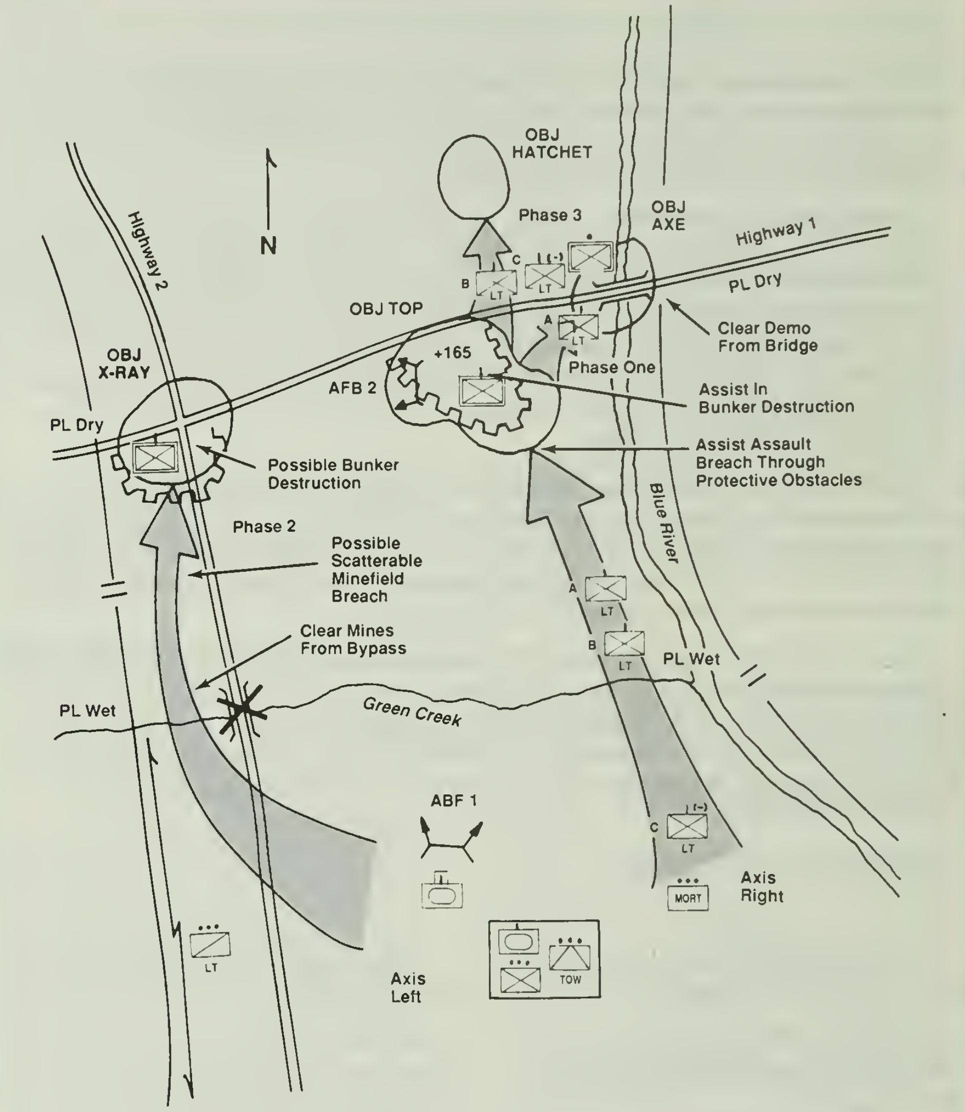


Figure 3. Engineer Working Overlay

assumption that the task force will not receive additional assets.

Step 3 ***Develop a scheme of engineer operations.*** The goal of this step is to allocate the resources available to accomplish tasks identified in Step 2. Experiment with various resource allocations, considering the task force' mission and the commander's intent. As assets become scarce, determine where they can reasonably accomplish several tasks. Determine where maneuver elements may be called upon to accomplish engineer tasks, or revise your estimates.

Step 4 ***Balance force allocations with available assets.*** In this problem, Axis Right has priority. At the end of Phase 1, an engineer platoon is needed at

Engineer Solution

the bridge over the Blue River, and three engineer fire teams are needed on OBJ TOP. Because the commander is more concerned about OBJ TOP than the bridge, Company B is allocated three fire teams. Company A, with assistance from one engineer fire team, must remove demolitions from the bridge.

Two engineer squads may be required on Axis Left. One squad probably can accomplish most of the mobility tasks on the left with equipment organic to the armor company. If necessary, the infantry platoon will provide assistance.

Step 5. ***Integrate into maneuver course of action sketch.*** Prepare a statement describing the scheme of engineer operations. The statement must address—

- ▶ How engineer assets support the maneuver course of action
- ▶ Engineer mission priorities for each phase
- ▶ Critical engineer events and activities
- ▶ Task organization for combat

Wargame and refine engineer plan. Using the course of action developed in Step 1 through Step 5, visualize the operation as the TF commander. Begin with Phase 1 of the operation and continue through Phase 3. Note any shortfalls. Be aware of other staff members' plans and ensure all plans (including your's) are mutually supporting.

While wargaming this mission, you see a potential problem in Phase 1. Two engineer squads are attached to Company A for the assault breach, and then three of four engineer fire teams switch to Company B when they move into OBJ TOP. You decide to refine the plan and place yourself with Company A for the breaching operation. This will allow you to ensure the fire teams transition smoothly to Company B.

Recommend a course of action. According to the commander's intent, taking Hill 165 is key to the operation. Thus, the mobility tasks to breach through the protective obstacles and to provide fire teams to assist in destroying bunkers are the first priority. Because Company A is tasked to complete an assault breach into OBJ TOP, two engineer squads will be attached to it. Company B requires three engineer demolition teams to destroy bunkers, and Company A requires a platoon to clear the bridge of demolitions. The commander is more interested in securing Hill 165 than in keeping the bridge intact. Therefore, as Company B passes through Company A, it will pick up three engineer fire teams from Company A. The remaining engineer fire team will stay with Company A and assist that unit in clearing demolitions from the bridge.

Team Tank has three mineplows and one mine roller. In addition, the remaining sapper squad will be attached to Team Tank to breach potential obstacles on Axis Left and possible bunkers on OBJ X-RAY.

Should the additional engineer platoon requested from follow-on forces arrive, it will be allocated to Team Tank. In this case, the remaining sapper squad from your

Engineer Solution

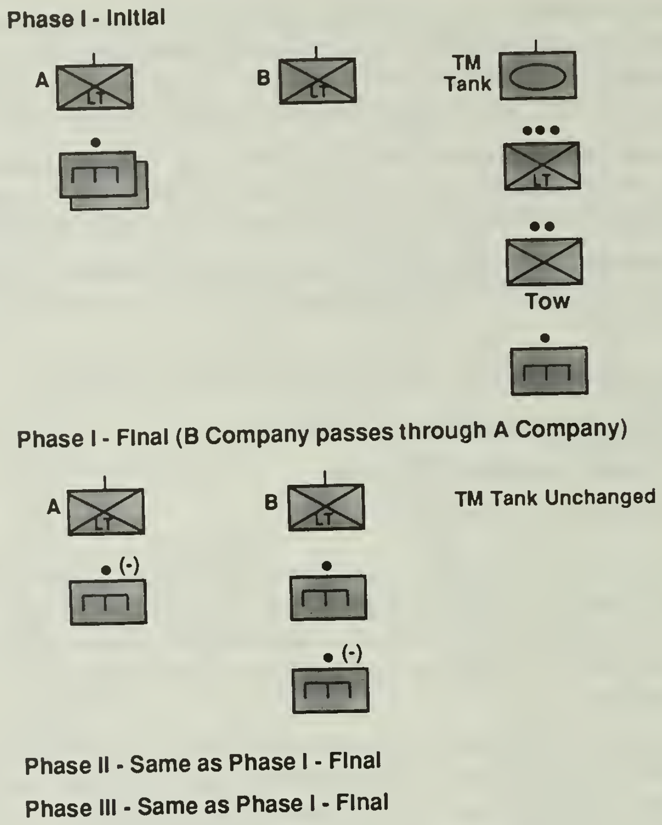

Phase I - Initial
A
LT
B
LT
TM
Tank
LT
Tow
Phase I - Final (B Company passes through A Company)
A
LT
(-)
B
LT
(-)
TM Tank Unchanged
Phase II - Same as Phase I - Final
Phase III - Same as Phase I - Final

Figure 4. Task Organization

platoon will be attached to Company A to assist with the assault breach mission.

The platoon leader will be with Company A for the breaching operation, and he will ensure that the three engineer fire teams transition properly to Company B. Because this is an assault breach, the engineer squads attached to Company A will be under the command and control of the infantry platoons that conduct the breaching operations. They will not be under the control of the engineer platoon leader (Figure 4).

This Engineer Problem was submitted by Captain Jon Jones and Captain Michael Premo. Captain Jones is currently assigned to the 554th Engineer Battalion, Fort Leonard Wood. Previous assignments include the 37th Engineer Battalion and as a task force engineer in the 2nd Infantry Division and the 82nd Airborne Division. Captain Premo is an instructor/writer in the Department of Combined Arms, U.S. Army Engineer School. He previously served as a platoon leader, 52nd Engineer Battalion, and commander, A Company, 79th Engineer Battalion.

A District's Environmental Learning Curve

By Colonel Wilbur H. Boutin, Jr.

The nation's growing awareness of the environment has led to a new mission for the Army. With the Corps of Engineers in the lead, the Army is playing a key role in cleaning up current and former Department of Defense (DOD) properties, and providing support to the Environmental Protection Agency in hazardous and toxic waste (HTW) operations.

To help expedite the Army's contribution to the cleanup effort, the Corps' Kansas City District has been designated as a design center for HTW activities. Design centers conduct the geotechnical groundwork that helps identify hazardous waste sites and provide recommendations for treatment. In its new role, the district will provide HTW operations support to DOD, the Environmental Protection Agency (EPA), and other federal agencies.

Background

The Corps is a logical choice to assist in the nation's HTW cleanup efforts. As early as 1982, the Corps provided assistance to the EPA in its efforts to manage and clean up the worst of the country's HTW locations—the so-called Superfund sites. What then appeared to be a transitory project for the Corps has now been mainstreamed into its future missions.

This early opportunity to learn the "ins and outs" of environmental program management has proven invaluable to the Corps. When the Superfund program was expanded in 1985 to include federal facilities, the Corps of Engineers enjoyed the advantage of considerable experience in the HTW field. Against a backdrop of growing national concern for the environment, a significant portion of Corps resources is being turned to the HTW effort. As a result, engineer officers assigned to Corps

Civilian contractors set up a drilling rig to dig an extraction well on an HTW site. The HTW field is a relatively new one for both private companies and the Army (J.M.S. Co., Inc. photo).

districts are likely to be heavily involved in such activities.

As "point man" for the HTW effort, the Corps operates on a solid foundation of support within DOD. Secretary of Defense Richard Cheney said in 1989 that he wanted the Department of Defense to be "...the Federal leader in agency environmental compliance and protection." Lieutenant General Hatch, Chief of Engineers, has taken that mandate and made the environmental mission part of his vision for the Corps' future.

Mission Overview

Our HTW missions fall into two broad categories: support of the EPA, and support of DOD environmental programs. Support for the EPA includes design work, construction contract management, and technical support. Of course, our work with the EPA leads to a broad range of cooperative projects with both private industry and other government agencies, such as the Department of Energy.

Within DOD, a significant portion of our work deals with the management of government-owned sites which may need rehabilitation. For such sites, we provide preliminary assessments, investigations and feasibility studies, and remedial design. If necessary, we can also provide remedial or cleanup action. Additionally, we provide DOD organizations with legal representation in what we call "potentially responsible party" (PRP) negotiations. This usually involves a DOD organization which was a previous tenant—or current tenant—of a site which now has a HTW problem.

Be Prepared

Army engineers can expect significant demands on their time and expertise in the rapidly expanding HTW field. For the young engineer officer who may one day serve in the Corps, the lessons we've learned in the Kansas City District may prove valuable. What follows is some general advice in the areas of customer support, staffing, contracting, regulatory compliance, and innovative technology.

Customer Support

Once a course of action is selected for an HTW site, the focus of project management will generally shift to the district office during the remedial design phase. In its role as a quasi-contractor for the EPA and other federal agencies, the district must view customer support—especially during remedial design and action—as a central part of its duties. There are alternative sources of expertise, both government and private-sector, available to our customers. If we are not sufficiently responsive to their needs, they will go elsewhere. Make sure your scheduling requirements are straight, and your projects on-line. The HTW mission is an important one for the Corps and for Army engineers in general. We don't want to lose it.

Another aspect of customer support is our duty to the public. Include public participation in your programs whenever possible. Environmental citizen-action groups may express their concern about your activities, and they will be vocal about the pros and cons of district activities. So don't ignore the public. Work with your public affairs office to develop a public involvement/public information plan so your energies won't be diverted from your engineering tasks.

Staffing

In the HTW field, staffing is a primary consideration for both the government and the private sector. Demand for qualified personnel exceeds the supply. Sometimes it's difficult to find sufficient personnel with the technical expertise to oversee contractors and quality control for field activities. Keep in mind that most of the contractors you will deal with are having the same trouble hiring and retaining experienced HTW professionals. Often, relatively inexperienced contractor personnel are handling difficult environmental assignments with little internal oversight or review.

Engineer action officers and project managers working in the HTW field should carefully consider whether they have adequate personnel resources. If not, they need to get the system working to fill authorized positions.

Contracting

Contracting for HTW operations is difficult and challenging. Many aspects of these projects don't fit neatly under construction or service contracts. Unpredictable work requirements, highly advanced technologies, and widely varying site conditions can complicate even the smallest project.

A good example is subsurface contamination remediation projects. Site characterization and problem definition are critical to putting together a sound contract. But these are difficult things to determine. This means accurate cost estimates are nearly impossible until the project is well into the design phase. This is quite a switch from the typical construction projects most engineers are familiar with.

The contracting strategy should be pinned down early in the development of each project, especially if sole-source contracting is needed to obtain a specific technology. Current working estimates (CWE) on computer-aided drafting and design (CADD) projects need to be continuously updated. This will help avoid unpleasant surprises when you get ready to award a contract. This is particularly true if you will be using someone else's design. One of the innovative contracting methods we're pursuing is a large, indefinite-delivery architect/engineer contract, with a $2 million limit per delivery order, and a $20 million total contract limit.

Bonding for HTW work is also a major consideration, and is particularly important in light of heightened public interest in such projects. If the government determines that the public interest needs protection during the course of a particular project, all HTW contracts, from service (normally requiring no bond) to construction

A private contractor tests the perimeter of a hazardous and toxic waste landfill site. District offices of the Army Corps of Engineers often work with private firms in the management and cleanup of HTW materials (J.M.S. Co., Inc. photo).

(requiring 100 percent bonding) can have a bond requirement imposed. Several contractors have discovered that environmental activism and protection of the public trust are major considerations in pursuing HTW work—and can influence bonding requirements.

Regulatory Compliance

As mentioned earlier, HTW activities often do not fit neatly into the regulations—even guidelines that have been written expressly for that purpose. State and EPA regulations can often differ on HTW matters, and each can take precedence over Corps guidelines and procedures. We've found that some regulations even contradict each other. So early on, establish contact with personnel in other agencies who are knowledgeable about their HTW regulations, and can help guide your actions.

But don't count entirely on other agencies. Develop a working familiarity with all HTW regulations. The smallest oversight can ensnare a project for weeks or even months. You must have a thorough knowledge of regulations, site conditions, and remediation technologies in order to prepare sound proposals.

To be a fully functioning member of a district's HTW team, you must also be familiar with the Comprehensive Environmental Response, Compensation and Liability Act (CERLA), and the RCRA. Superfund sites and most formerly used defense sites (FUDS), fall under CERLA. Installation Restoration Program (IRP) sites may be covered by either CERLA or RCRA.

Innovative Technologies

Don't be afraid to use innovative technologies in solving HTW problems. The advantages can sometimes be significant, and the additional risk can be minimized by making full use of treatability studies. Such studies will indicate the applicability of specific technologies for each site.

Also make sure that you are properly sequencing your project. Your project planning process should include opportunities to discard the technology if it proves ineffective or too expensive. In other words, have a backup plan.

When considering new technologies, use design firms with extensive remedial design experience and a proven record for design implementation. The combination of innovative technologies and HTW can be extremely challenging. You want to deal with a firm that already knows the ropes. In any event, require contract firms to do thorough research of existing literature and field application problems. The design effort necessary to implement innovative technologies is often greater than most firms are accustomed to.

To further minimize risk, try to perform pilot-scale field demonstrations at your site prior to full-scale operations. This will help avoid costly contractor claims resulting from unforeseen problems and delays. Also, be wary of incomplete data sets which appear to prove the proposed technology—even if the data was derived from a previous full-scale operation.

Don't lose sight of the fact that an innovative technology is usually only part of the site treatment process. Associated operations like material handling, soil moisture, and disposal of side streams may be difficult to accomplish.

Be realistic about matching a new technology with site cleanup criteria. A particular technology may provide significant advantages at a particular site, but may not be effective enough to meet the required cleanup standards. We have found, however, that cleanup criteria may be legitimately "softened" to accommodate a particular technology. The EPA's Technology Innovation Office is a good source of information and support when considering the use of innovative technology.

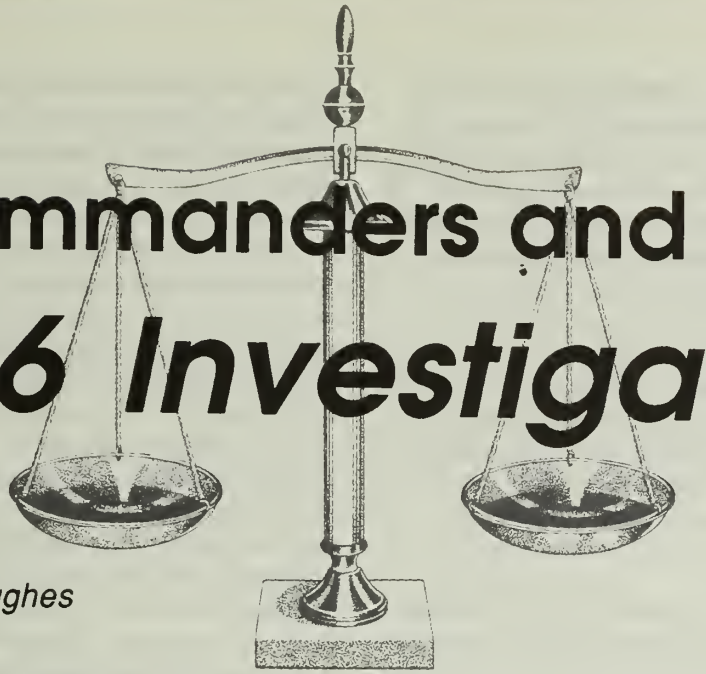
The Challenge

The Corps has taken the lead in DOD efforts to clean up and control our hazardous and toxic waste problem. For officers serving in an engineer district, HTW operations promise an exciting, demanding challenge. Traditional engineering skills will still be needed, backed by new expertise gained in the HTW field over the past several years.

The road has not been easy so far. Mistakes have been made, partly because the problem is so large, and partly because engineers—military and civilian alike—are still on the upward side of the HTW learning curve. But getting a handle on HTW is now a significant part of the Corps—and the country's—future.

I hope that our experiences will serve others who will come to meet the challenge.

Colonel Boutin is the Kansas City District Engineer. He previously served as deputy commander of the 18th Engineer Brigade. He also commanded the 5th Engineer Battalion, as well as engineer units in Vietnam and Germany. Previous engineer district service includes a tour with the New York District as assistant chief of operations, and chief of the Regulatory Branch. He holds a bachelors degree in engineering management from the University of Missouri at Rolla, and a masters degree in business administration from Boston University.



Commanders and the 15-6 Investigation

By Captain Andy K. Hughes

The military justice system enjoys a well-deserved reputation, even among the nation's civilian law community, for procedural fairness. Through the informal 15-6 investigation, the Army's legal framework also gives commanders flexibility in handling disciplinary matters which may not warrant immediate criminal investigation.

All commanders—and all leaders, both officer and NCO—need to be aware of the informal 15-6 and how it works. This article explores this legal option which, like the famous Dragnet line, gives "just the facts, ma'am."

For Example

A battalion commander receives information that one of the higher ranking men in his unit may be fraternizing with junior female enlisted soldiers. The allegations include information that the man might be using his rank and position to influence the emale soldiers into "sex-for-favors" situations.

For obvious reasons, the battalion commander must find out the truth about these allegations in the nterest of his unit's good order and discipline. On the other hand, the commander doesn't yet want a formal criminal investigation by military police or agents of he U. S. Army Criminal Investigation Command USACIDC). Until he has further information, he wants to protect the man from the professionally embarrassing spotlight that a full criminal investigation would bring.

Getting the Investigation Started

The first two things that the battalion commander must decide appear simple on the surface, but are critical to the success of the investigation:

- Who should conduct the investigation?
- What should be the scope of the investigation?

Army Regulation 15-6 directs that unless the investigator possesses certain technical qualifications that are essential to completing the proposed investigation, the investigator will be an officer (including warrant officers). As a matter of common sense, the commander should select an officer who, in his opinion, has the ability, judgment, and maturity required to conduct a thorough investigation.

The commander should also decide what area(s) of concern the investigator should look into. Since the investigation is informal, the answer to this question is limited only by the commander's discretion. A common method that commanders use to determine what areas should be investigated is to make a list of questions that the commander would like the investigator to answer. This list will become important as a means of expressing the commander's intent concerning the investigation and providing initial guidance to the investigating officer.

After the commander makes these first two determinations, the next step is to appoint the investigating officer and brief him on the mission. Although this information can be given to the investigating officer verbally by the commander, a much better method is through a memorandum of appointment to the investigating officer. This memorandum should contain, at a minimum, the following:

- A statement that the officer has been appointed to conduct an informal investigation concerning certain allegations.
- The area(s) which the investigator must cover, and on which he must make findings and

recommendations (this is similar to the mission statement in an operations order). The commander should include the list of questions developed earlier to assist the investigator in focusing his investigation. However, the investigator should be told that the list of questions is not all inclusive, and he should use discretion.

- The method for reporting to the commander any findings and recommendations made (verbal or written), and the names of persons to contact for special assistance or administrative support (such as legal advisors, technical experts, or typists).
- The suspense for the completion of the investigation and procedures for extending that suspense if needed.

Once this memorandum is completed and presented to the investigating officer, the investigation has begun. The investigating officer is now prepared to start his work.

Conducting the Investigation

After he receives the appointment memorandum (or other guidance), the investigating officer's method of proceeding can almost be defined by the famed musical title "Anything Goes." Unless his appointment memorandum directs otherwise, the investigating officer may obtain statements (both sworn and unsworn) from witnesses, copies of documents, summarized records of oral conversations, or any other source of information that will yield "just the facts."

However, there are some practical considerations that investigating officers should take into account while conducting their investigation. One such consideration is that the regulation indicates a preference for sworn statements compared to unsworn statements. The reason for this preference is twofold: The requirement of an oath or affirmation impresses upon persons giving statements the importance of the truth. Secondly, if it is later discovered that someone knowingly made a false statement, they can be prosecuted for false swearing under Article 134 of the Uniform Code of Military Justice (for military personnel) or Section 1001, Title 18, United States Code (for civilians). Since investigating officers are authorized to administer oaths (Sections 936 and 1044a, Title 10, United States Code), sworn statements should be taken whenever possible, using either DA Form 2823 or its equivalent.

Another consideration is whether an individual should be advised of their rights against self-incrimination under either Article 31, Uniform Code of Military Justice, or under the Fifth Amendment to the Constitution of the United States (the so-called "Miranda" rights) prior to conducting an interview. The general rule is that since no individual is designated as a respondent in an informal investigation, the individual does not have any of the "rights" of a respondent (which includes a rights warning). Therefore, in an informal 15-6 investigation, the investigating officer is not required to provide a rights warning in advance unless he has information leading him to suspect that the person may be guilty of a crime. If the question is too close to call, the investigating officer should get guidance from a legal advisor.

However, like most general rules, there are exceptions. For example, during the course of an interview, if the person being interviewed begins to make statements that may tend to incriminate him for being involved in criminal acts, then the prudent investigating officer should stop the interview and advise him of his rights.

A rights warning certificate (DA Form 3881) should be used to advise the person of his rights and to determine if the person wants to proceed with the interview. If the individual wishes to consult with counsel before proceeding, the interview should be terminated and the individual allowed to seek legal assistance.

In light of recent decisions of the U. S. Supreme Court, if an individual consults with counsel, the individual should not be further questioned unless either the individual comes to the investigating officer and wishes to make a statement, or counsel for the individual is present during the interview.

So while the investigating officer has wide discretion as to his procedures for conducting the investigation, that discretion is not unlimited. The wise investigator should consult legal counsel at the outset of his investigation, and develop a plan or road map for how he plans to conduct the investigation. He should maintain contact with his legal advisor until the mission is completed.

The Final Report

Gathering information is only half of the investigating officer's job. The officer must now organize that information into a form that his appointing authority (the battalion commander in the example above) can easily understand. Depending on the scope of the investigation, this task can be relatively simple or extremely complicated.

The investigating officer must examine all of the material he has gathered, and make findings of fact based upon the evidence he has discovered. Usually, these findings are made in narrative form, and should answer the questions or issues that the investigating officer was tasked to answer in the appointment memorandum. In addition, the investigating officer should recommend to the commander actions that should be taken in light of the findings.

Unless the appointment memorandum states otherwise, the exact form of the report is left to the discretion of the investigating officer. DA Form 1574 is a recommended tool that can be used to organize the report, but its use is not required. The report should contain the findings, recommendations, and copies of all documents (witness statements, etc.) which the investigating officer used to make his findings. These documents should be marked as lettered exhibits to the report (for example, "Exhibit A").

The findings should reference the exhibits upon which the investigating officer based each of his findings of fact. This will assist the commander in understanding the investigating officer's thought process.

In all reports, the answers to the following questions must be 'yes':

- Are the findings consistent with the evidence? If the investigating officer makes a finding of fact that is not supported by the attached evidence in the report, then the finding is improper. For example, a finding based upon pure speculation must not be included in the report. However, it is acceptable to make a finding of fact based on the investigating officer's determination of which witnesses are telling the truth.
- Are the recommendations consistent with the findings? To illustrate, assume that the investigating officer in the example found that the man in question was involved in a fraternization situation with a junior enlisted woman. However, in this case, the investigating officer recommended that no disciplinary action be taken and that the man be reassigned to division headquarters. It's obvious that either the investigating officer did not make sufficient findings of fact (maybe the man shouldn't be disciplined, but the investigating officer did not explain his reasoning). Or, the recommendation is inconsistent with the finding that the man was engaged in misconduct (a consistent recommendation might be a recommendation of some form of administrative action or discipline against the NCO).

To insure that reports are properly prepared, investigating officers should obtain assistance from legal counsel.

Post-Report Actions

After the commander receives the report, several events may take place. The commander may approve all of the findings, or may approve some of them. The commander who initiated the investigation is not bound by the findings of fact or the recommendations of the investigating officer. He may draw different conclusions from the evidence and take a course of action other than that recommended by the investigating officer. He may direct that the original investigating officer (or officer appointed to succeed the original investigating officer) conduct further investigation concerning areas previously stated in the memorandum of appointment or into additional areas.

If the commander wishes to look into additional areas, he should give the investigating officer a supplemental memorandum outlining them. If the commander wishes additional areas explored, the report should be amended to incorporate these new areas.

The commander may use the report of investigation in a variety of ways. It could, for example, be the basis for referring a case to the USACIDC, for relieving an officer, for initiating a report of survey, or for revising administrative procedures in the unit.

Just the Facts

In the example of the alleged fraternization case, if both the battalion commander and the investigating officer follow the guidance described in this article, the result should be a report that clearly states "just the facts" to the battalion commander and makes recommendations supported by the evidence. With the facts discovered in the informal 15-6 investigation, the battalion commander should be in a far better position to make an intelligent decision about whether to take action himself or to refer the matter for possible criminal investigation.

This flexibility makes the informal 15-6 investigation, when properly executed, one of the most effective and useful investigative techniques available.

Captain Hughes is chief of the Administrative Law Branch of Fort Leonard Wood's Staff Judge Advocate. He previously served as Administrative Law Attorney in the same office. Other assignments include senior defense counsel, trial counsel, and legal assistance officer for Fort Rucker's Staff Judge Advocate. He is a graduate of Combined Arms and Services Staff School. Captain Hughes received his law degree from the University of Mississippi.

ENGINEER UPDATE

Autovon numbers are 676-XXXX, and commercial numbers are (314) 563-XXXX, unless otherwise written.

Directorate of Training and Doctrine (DOTD)

New Director Welcomed. DOTD welcomed LTC Robert Martin as director in June. LTC Martin last served as director of the Engineer School's Department of Military Engineering. COL John Pierce left in June to assume his new position as commander, U.S. Army Engineer District-Alaska.

Engineer Hotline. For hard-to-find information regarding military engineer issues, call the engineer hotline at -7324. The service is available 24 hours a day, seven days a week. Most questions are answered within one or two working days—we are here to serve you! POC is SGM Donald Rasmus, -7528.

Combined Arms Training Strategies (CATS). Starting in FY 92, CATS will incorporate a tailored training strategy in Mission Training Plans (MTP). The first set of CATS will be included in ARTEP 5-605-series MTP (topographic engineering). POC is CPT Jim Glass, -7784.

***ARTEP 5-145-32 and 5-145-12-MTPs,* Bridge Company and Platoon.** New MTPs for engineer bridge companies and platoons will be distributed in the 4th quarter, FY 91. These MTPs, which replace ARTEP 5-64, dated July 1982, provide training and evaluation guidance for units with assault float, medium girder, panel, and M4T6 class 60 bridges. POC is Russ Hinkle, -7513/7786.

Medium Equipment Transporter Training Package. An exportable training package will beavailable in the 4th quarter, FY 91, for the M916 and M920 truck-trailer combination vehicles. The 13-day program includes preventive maintenance checks and services (PMCS), engine brake (Jake's brake), and driving techniques for the M916 (with M172A2) and M920 (with M870). The package will be available upon request from the Individual Training Branch, DOTD. POC is CPT Karl Rhynes, -6144/7785.

Directorate of Combat Developments (DCD)

AN/PSS-12 Mine Detector. Purchase of the sensitive AN/PSS-12 Mine Detector for distribution to Army units depends on results of an in-process review scheduled for August 1991. The AN/PSS-12 is a hand-held, portable mine detector that can detect buried metallic antitank and antipersonnel mines, and small metallic firing pins on buried non-metallic controls. The device weighs about 8 pounds; its handle extends from 19 to 57 inches.

The mine detector will be used by combat, combat support, and combat service support troops in both forward and rear areas to locate land mines and unexploded ordnance. Initial basis of issue will be one-for-one replacement of the AN/PSS-11/12 mine detectors, followed by other combat support and combat service support units. POC is SFC Wilder, -7993.

Directorate of Evaluation and Standardization (DOES)

Special Projects and Studies. The Engineer School matches requests from students for thesis research projects with topics submitted from agencies and units for research. The research will be performed at the Command and General Staff College, War College, equivalent Department of Defense schools, or graduate schools. If your agency or unit has a topic to submit, or if you are a student seeking a thesis topic, call CPT Martin Dorey, -5321.

Department of Instruction (DOI)

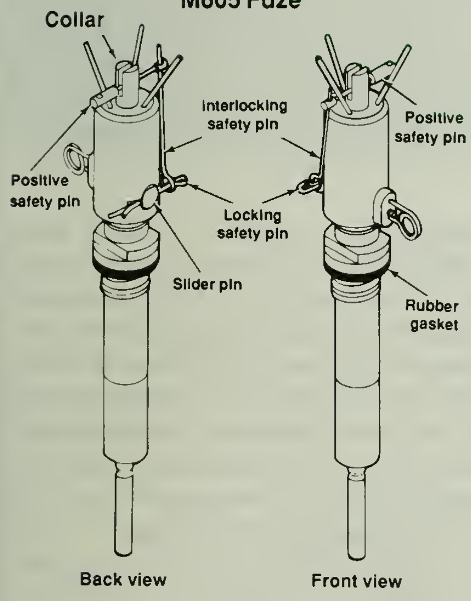
Engineer School Reorganization. Effective 17 June, the Departments of Combined Arms and Military Engineering were reorganized into a single department, the Department of Instruction. This move was made to consolidate all teaching requirements into one department, and to create overhead space savings for the school. Faces, phone numbers, and office locations initially will not change much. As they do, additional announcements will be made in *ENGINEER*.

Request you bear with us and have patience when dealing with DOI. We will continue to support the field in the same manner that DCA and DME did in the past. When writing to us, the new office symbols are:

ATSE-DI — Director
ATSE-DI-CE — Combat Engineering Division
ATSE-DI-CC — Combat Construction Division
ATSE-DI-AC — Engineering Office Advanced Course Division
ATSE-DI-TT — Tactics, Training, and Doctrine Division

POC is SFC John Williamson, -5746.

M605 Fuze



Additional Arming/Disarming Procedures for M16 Series Antipersonnel Mine (M605 Fuze). The following information is in addition to the procedures published on page 46 of the January 1991 issue of *ENGINEER Professional Bulletin.*

▶ M16 mines must have collars on the M605 fuze. The collar provides additional clearance between the striker and primer, adding a greater margin of safety in case the striker is accidentally released. When arming or disarming the M605 fuze, soldiers must ensure that the metal collar over the top of the striker is in place.

▶ The term "collar" refers to the cylindrical piece of metal that slides over the top of the firing pin. It rests on the upper-most part of the fuze body, between the three prongs. The collar has a slot that lines up with the hole in the striker (firing pin). When the positive safety pin is inserted through the slot in the collar and the hole in the striker (firing pin), the collar helps prevent the striker from making contact with the primer.

▶ The collar comes with the fuze when it is first issued; it is not an additional part. The metal collar should not be discarded when arming the fuze. It must be in place before attempting to insert the positive safety pin. If the collar is missing from the fuze, do not arm or disarm the mine. POC is CPT Green, -5596.

Department of Topographic Engineering (DTE)

Director Change. In June we said farewell to our director, COL Kirby, who will become director of the Defense Mapping Agency's Hydrographic and Topographic Center, in Washington, D.C.

We will welcome the new director, LTC Schnabel, in August. LTC Schnabel is commander of the 29th Engineer Battalion, Fort Shafter, Hawaii.

Engineer Branch Safety Office (EBSO)

Road Grader Operation Update. An item in the January 1991 issue of *ENGINEER* (p. 45) reported that road grader operators should stand up when moving the vehicle in reverse. That statement is true for all older model road graders used by the military (Caterpillar 120 and Westinghouse 440 HAHA).

Caterpillar M130G road graders operate differently. Operators must remain seated with the seatbelt on when moving this vehicle in reverse. POC is Paul Rusinko, -5002.

Engineer Personnel Proponency Office (EPPO)

Army Diving Open to Women. Military occupational specialty (MOS) 00B, Diver, is now open to female soldiers. This decision opens 153 Active, National Guard, and Army Reserve positions to female soldiers. POC is SFC Eelman, -5361.

Reserve Component (RC)

Army National Guard (ARNG) Officer Welcomed. Effective 8 July, 1991, LTC Mark L. Juneau (LAARNG) assumed the duties of assistant deputy assistant commandant ARNG at the U.S. Army Engineer School. He replaces LTC Charles Doll (OHARNG), who was selected as a senior service college fellow at Tufts University, Fletcher School of Law and Diplomacy. LTC Juneau may be reached at -7742.

1st Engineer Brigade

Reorganization and Realignment. Engineer training units at Fort Leonard Wood are being realigned under a multi-phase plan to bring the installation in line with the TRADOC school model. The 31st, 35th, and 589th Engineer Battalions (one station unit training) are now attached to the 3d Training Brigade. The 577th Engineer Battalion will inactivate on 12 July, and its horizontal construction and engineer equipment maintenance training missions will transfer to the 87th Engineer Battalion. The final phase of the reorganization will redesignate the 1st Engineer Brigade as the 1st Engineer Brigade (Center). It will absorb missions and units from the 136th Engineer Brigade, which will inactivate 20 July. POC is CPT David Kline, AV 581-4128, or (314) 596-4128.

Past in Review

CLEANUP IN THE ALEUTIANS

By Charles Hendricks

Few locations in the United States have endured as dramatic a physical impact from warfare in this century as Alaska's Aleutian Islands. Scene of the only foreign military occupation and land combat in the 50 states during World War II, these islands until recently remained scarred by the aftereffects of hasty military construction and rapid post-war demobilization.

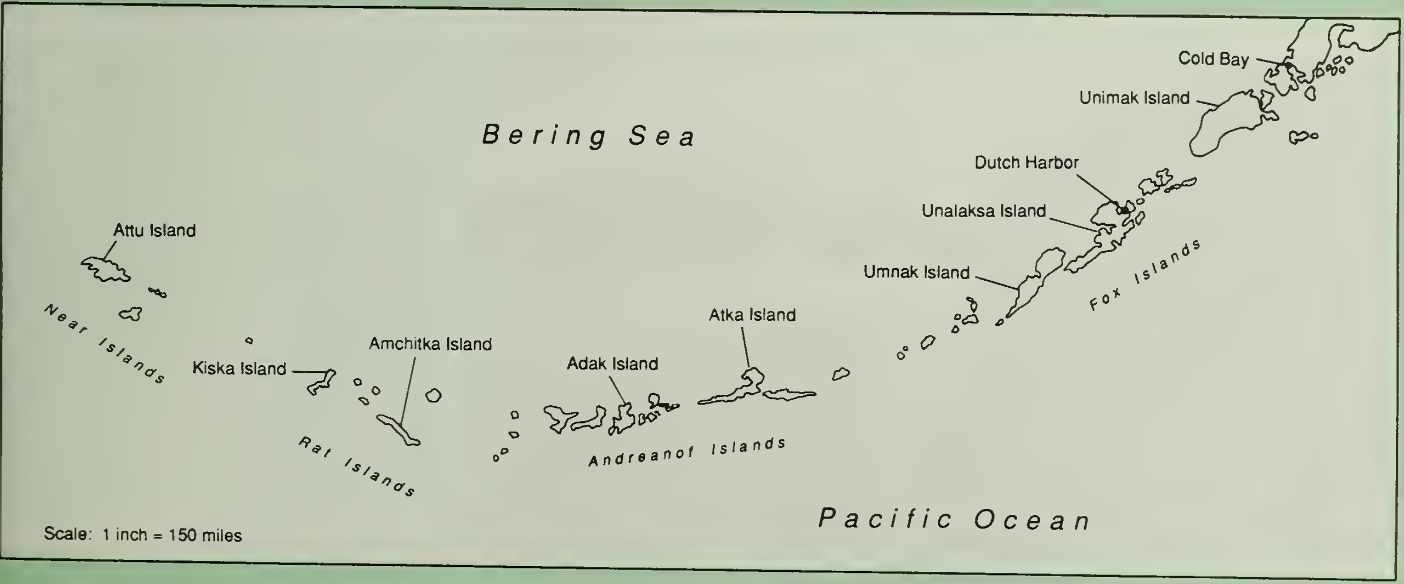
The Corps of Engineers has now begun a broad effort to clean up unsightly remnants of World War II on these once pristine islands. At the same time, engineers are collecting artifacts and records that preserve the memory of the area's significant historical events. Alaska's story, although unique, portrays the magnitude of the environmental restoration effort currently confronting the Department of Defense.

In 1940 the United States began to build substantial facilities for naval and land forces at Dutch Harbor, near the eastern end of the archipelago. These forces were assigned to defend the islands from the threat of Japanese aggression. Unalaska Bay, on which Dutch Harbor was situated, had been the commercial hub of the Aleutian Islands since Russian traders settled there in the 18th century.

Navy contractors and troops, including the first Seabee construction regiment, built a $44 million operating base at Dutch Harbor during the period 1940-44. It included a seaplane station, submarine base, Marine barracks, and radio facilities. The base had 17 office buildings, a 200-bed hospital, and seven operating docks. Navy builders also erected a typical Army mobilization-type garrison for 10,000 men adjacent to the Navy base. When the buildup of forces made it desirable for Navy personnel to occupy those facilities, Seabees built another Army base on nearby Unalaska Island. Army engineers, meanwhile, built an airfield on Umnak Island, just west of Unalaska Island.

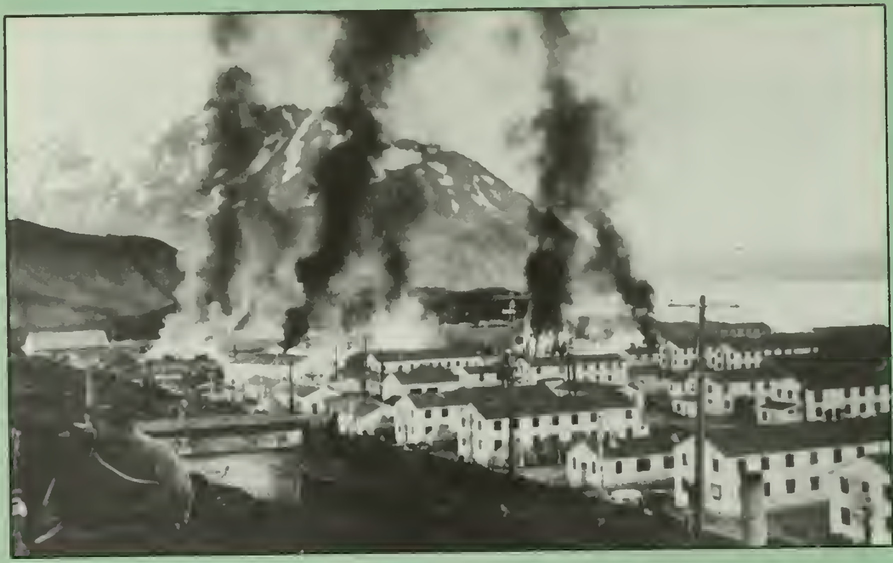
Japanese planes bombed Dutch Harbor in early June 1942 in an unsuccessful attempt to divert American forces from the critical battle at Midway Island. Attacking aircraft destroyed two Army barracks and four large oil tanks; damaged three quonset huts, a hospital, and a naval radio station; and set the barracks ship *Northwestern* afire. American fighters at Umnak engaged the Japanese planes but lost eight aircraft to the enemy's seven. American ground casualties amounted to 43 killed and 50 wounded.

Immediately after this attack, Japanese seized the undefended islands of Attu and Kiska, in the western Aleutians. At this point, the U.S. Army recognized the serious threat that the Japanese posed to the predominantly Native American population inhabiting the island chain. The Army reacted by hastily evacuating most native Aleuts in the Aleutian and nearby Pribilof Islands to camps in the Alaskan panhandle. The residents of Attu, unfortunately, were interned by the Japanese in Japan.



Aleutian Islands

Dutch Harbor. . .



During 1942 bombing raid

In disrepair

After 1985 restoration

General Simon Bolivar Buckner, commander of the Army's Alaska Defense Command, responded to the Japanese attacks by expanding Army bases on the Alaska Peninsula and pushing his forces westward from island to island in the Aleutians. By January 1943 Buckner's forces, which included U.S. and Canadian troops, had reached Amchitka Island, 80 miles southeast of Kiska. Army engineers quickly constructed airfields on the occupied islands, which enabled American fighters and bombers to launch destructive raids on the Japanese garrisons at Kiska and Attu.

When 11,000 American forces landed on Attu on May 11, 1943, they found 2,400 Japanese well entrenched on the island's rocky heights. The Japanese were in no mood to surrender, and only a combination of intense naval shelling, aerial bombardments, and ground attacks eventually forced them from their mountaintop positions. Before the battle ended 18 days later, the American commander had been relieved, 550 Americans had been killed, and 1,150 had been wounded. Only 29 Japanese were taken prisoner.

The Aleutian campaign came to an anticlimactic end in August 1943, when 34,000 allied troops landed on Kiska. The assault troops soon learned that the estimated 9,000 to 10,000 Japanese had already been evacuated. The Americans, nonetheless, suffered 21 killed from friendly fire in the operation.

After the Japanese in the Aleutians were defeated, the number of U.S. and Canadian troops in Alaska, which had reached 144,000 in September 1943, declined steadily. By the war's end, most of Alaska's wartime military installations were abandoned, except for substantial garrisons near Anchorage and Fairbanks, on Kodiak Island, and at

Adak Island in the Aleutians.

The displaced Aleuts returned to their islands in 1944 and 1945 only to find their homes ransacked or destroyed. The Aleuts' Russian Orthodox churches had been vandalized, and the village on battle-torn Attu had been obliterated. The United States spent $250,000 after the war rehabilitating the Aleut communities, but the money did not adequately compensate for the damage inflicted by souvenir-hungry troops. Many small Aleut settlements were abandoned. While the federal government built 24 homes on Atka, including six for Attuan families returning from Japan, most Aleuts had to rebuild as best they could on their own. Many found useful building materials at abandoned military facilities.

The Aleutian economy improved significantly in the 1970s, aided by the United States' declaration of a 200-mile domestic fishing zone in 1976. Also, the Native Land Claims Settlement Act of 1971 provided substantial benefits to the Aleut community. In the midst of this prosperity, the continued presence of dilapidated, abandoned military buildings formed an unsightly contrast.

Congress asked the Corps of Engineers to plan the removal of abandoned military buildings in the Aleutian Islands and at the two largest wartime installations on the Alaska Peninsula in a 1974 water resources act. During the next five years, the Corps' Alaska District prepared two inventory and planning documents for the environmental restoration work. It concluded that a respectable cleanup would cost at least $22 million.

Recognizing the magnitude of the military cleanup problem throughout the United States, Alaska's Senator Ted Stevens proposed, and Congress in December 1983 enacted, legislation creating a Defense Environmental Restoration Account. This account contained appropriated funds that could be used only to clean up hazardous wastes and unsafe and unsightly buildings and debris at current and formerly used defense sites.

The Corps' Alaska District moved quickly to clean up Aleutian and Pribilof Island sites. By 1985, the district had awarded contracts totaling $2.8 million to clean up Dutch Harbor and Unalaska Island, $4.4 million for environmental restoration at Atka and Amchitka Islands, and $2.8 million for clean-up work at Cold Bay.

The Corps maintained a lively interest in historic preservation as it undertook the cleanup operations. Joined in its effort by the State of Alaska's Historic Preservation Office and the National Park Service, the Corps carefully documented wartime construction in Alaska and preserved the best surviving structures. Project staff recorded detailed structural information about several historic sites before buildings were razed. These included the Navy's administrative headquarters at Dutch Harbor, the first Marine barracks erected there in 1940, and the air operations building, which later served for 37 years as Dutch Harbor's airline terminal. The group also documented the standard Pacific hut, a lightweight, easily assembled plywood structure similar in design to the steel quonset hut. Pacific huts had proliferated in the Aleutians during the war, proving impervious to the wind and rain for which the islands are renowned.

Cleanup operations were especially extensive on isolated Amchitka and Atka Islands. On Amchitka, the contractor removed 417 frame buildings, more than 1,500 quonset and Pacific huts, 3,300 barrels, 129 tanks, and some 37,000 cubic yards of wood and metal debris. A Corps contractor removed thousands of 55-gallon oil drums and excavated oil-saturated soils from a landfill site used by the military in the Pribilof Islands.

While these cleanup efforts were underway, the National Park Service conducted a survey of wartime sites in the Aleutians. The Park Service's study led to national historic landmark status for the Attu battlefield and Army and Navy airfields on Attu Island, the Japanese occupation site on Kiska Island, Army and Navy bases on Adak Island and at Dutch Harbor, and the Umnak Island airfield. The U.S. Fish and Wildlife Service now administers the once-occupied Kiska and Attu Islands as part of its Aleutian Islands National Wildlife Refuge.

The initial defense environmental restoration projects in the Aleutians have been completed, but work continues on recently issued contracts. These include a $7.6 million contract for site restoration at Port Heiden, on the Alaska Peninsula, where an Army base was built after the 1942 bombing raid at Dutch Harbor. Two contracts totaling $1.7 million have been awarded for additional restoration work at Dutch Harbor and Unalaska Island.

More work is in the offing. The Alaska District will survey the environmental restoration needs of Attu and Kiska Islands this summer, in advance of anticipated work there. These projects, aimed at removing the scars of war from a land of great natural beauty, form a colorful part of the more than $300 million of defense environmental restoration work which the Corps of Engineers executes annually.

Charles Hendricks is a historian, Office of History, U.S. Army Corps of Engineers, Fort Belvoir, VA. He earned a PhD in history from Cornell University.

DEPARTMENT OF THE ARMY
ENGINEER PROFESSIONAL BULLETIN
US ARMY ENGINEER SCHOOL
ATTN: ATSE-TDM-PB
FORT LEONARD WOOD, MO 65473-6650

USPS 522-390
OFFICIAL BUSINESS

SECOND CLASS MAIL
POSTAGE AND FEES PAID
DEPARTMENT OF THE ARMY
USPS 0000-[illegible]

UNITED STATES · ENVIRONMENTAL PROTECTION AGENCY ·

PIN 0[illegible]

205

ENGINEERING

DEC 17 1991

Engineer

E PROFESSIONAL BULLETIN FOR ARMY ENGINEERS
adquarters, Department of the Army

October 1991

ENGINEER TACTICS

DEPOSITORY
DEC 09 1991
UNIVERSITY OF ILLINOIS

PB 5-91-4

Approved for public release; distribution is unlimited

CLEAR THE WAY

By Brigadier General Daniel W. Christman
Commandant, U.S. Army Engineer School

The old and stable Army mold is being broken. The Army of this decade will be smaller, primarily CONUS based, and must be trained and ready for contingency operations anywhere in the world.

This will drive changes in the way engineers do their jobs. We must be forward-looking and design doctrine and equipment that will allow us to accomplish future engineer battlefield missions. At the Engineer Center we are doing just that. Working together, we will establish a sound foundation for Army engineers in the 21st century.

I've talked to many of you in my first two months as Commandant, and your feedback has helped me outline four priorities for engineers to successfully contend with the challenges of a complicated, diverse, and resource-constrained world. The first is professional development. We have done an excellent job in the past to prepare our junior engineer leaders, and I want that to continue. In this regard, I recommend you read TRADOC Pamphlet 525-5, dated 1 August 1991. This pamphlet previews the Army's Air-Land Operations concept and helps set the doctrinal azimuth we will be following in the 90s. It is an *extremely* important document!

Second is communication with the field. I want the school to do a better job in this area. As part of the team, you need to help us design and build the future combat engineer force. Since you deal with unit problems daily, I know you are identifying innovative solutions to solve them. A lot of great ideas are out there, but if you don't share them, they will only be great ideas for a few. In turn, we at the school need to stay in touch with you on the full range of issues on our plate. I'll do all I can at this end to open the communication lines.

I have already started working my third priority: force structure enhancements. Despite the successes of the Engineer Restructure Initiative (ERI), we do not yet have the final solution. We must keep ERI on track for the armored and mechanized divisions and watch out for "nibbling" on the margins. We still have to work out the structure at the corps level and above to ensure we can sustain the future contingency fight. This means we will look closely at the roles of combat heavy battalions, combat support equipment companies, and bridge companies.

Last but not least, we must work on equipment modernization. This is broken, and fixing it with the sharply reduced resources will not be easy. Mobility enhancements are a critical Army shortfall. Vern Lowrey's article on engineer observations from Desert Storm (pages 42-48) highlights our inability to breach complex obstacles quickly and effectively. We need to aggressively field the equipment required to accomplish our warfighting missions. The M1 breacher/bridger is, consequently, our number one equipment priority.

To meet these enormous challenges, we must maintain a sense of balance—a balance that places attention on our work and family priorities, and doing all that we do with a sense of purpose and humor. The teamwork we develop will help us speak with one voice for the engineer community and greatly enhance the effectiveness we will need in the demanding environment of the 90s.

We at the Engineer Center are committed to helping our Total Army "maintain the edge" during the transition to the smaller, quality force of the future. With your help, we will ensure engineers "Clear the Way" for this force, as we have for every force fielded by this nation since the founding of our Republic. Essayons!

Engineer

October 1991

Volume 21 PB 5-91-4

UNITED STATES ARMY ENGINEER CENTER AND FORT LEONARD WOOD

COMMANDER/COMMANDANT
Brigadier General Daniel W. Christman

MANAGING EDITOR
Catherine Eubanks

FEATURES EDITOR
Phillip R. Howell, Jr.

GRAPHIC DESIGNER
Jennifer C. Bolyard

By Order of the Secretary of the Army:

GORDON R. SULLIVAN
General, United States Army
Chief of Staff

Official:

PATRICIA P. HICKERSON
Brigadier General, United States Army
The Adjutant General

Cover photo: *Two armored combat earthmovers (ACEs) of the 9th Engineer Battalion move to their next objective during Operation Desert Storm (Photo by SFC Bob Crockett, VII Corps, Public Affairs Office).*

FEATURES

2 **The Engineer Role in Helping the Kurdish People**
by Colonel Stephen A. Winsor and Major Stephen D. Austin

10 **The Brigade Deliberate Breach**
by Major Greg S. Kuhr and Major John F. Antal

18 **Constructing Iraqi-Style Obstacles at the NTC**
by Captain Thomas E. Sawyer

26 **Engineers as Part of the Combined Arms Reconnaissance Team**
by Captain Bob Wray

35 **The Evolution of River Crossing Doctrine, 1918 to 1944**
by Captain Robert Toguchi

42 **Initial Engineer Observations by Engineers in the Gulf War**
by Vernon Lowrey

51 **The Quadripartite Working Group: Honing Engineer Standardization**
by Captain Kathryn M. Ohmann

DEPARTMENTS

Inside Front Cover: **Clear the Way**

9 **Personal Viewpoint**
22 **Engineer Problem**
32 **Lessons Learned**
49 **Engineer Solution**
55 **Engineer Update**
58 **Past in Review**
61 **Bridge the Gap**

ENGINEER (ISSN 0046-19890) is prepared quarterly by the U.S. Army Engineer School, ATTN: ATSE-TDM-PB, Fort Leonard Wood, MO 65473-6650. Second Class postage is paid at Fort Leonard Wood, MO, and additional mailing offices.

POSTMASTER; Send address changes to ENGINEER, the Professional Bulletin for Army Engineers, ATTN: ATSE-TDM-PB, Fort Leonard Wood, MO 65473-6650.

CORRESPONDENCE, letters to the editor, manuscripts, photographs, official unit requests to receive copies, and unit address changes should be sent to ENGINEER, at the preceding address. Telephone: (314) 563-7535, AV 676-7535.

DISCLAIMER: ENGINEER presents professional information designed to keep Army engineers informed of current and emerging developments within their areas of expertise. Views expressed are those of the author and do not necessarily reflect official Army or TRADOC positions, nor does the content change or supersede information in other official Army publications. ENGINEER reserves the right to edit material.

CONTENT is not copyrighted. Material may be reprinted if credit is given to ENGINEER and the author.

OFFICIAL DISTRIBUTION is targeted to all engineer and engineer-related units.

PERSONAL SUBSCRIPTIONS are available by contacting the Superintendent of Documents, ATTN: Chief, Mail List Branch, Stop SSOM, Washington, DC 20402. Address changes for personal subscriptions should also be sent to the Superintendent of Documents.

The Engineer Role in Helping the Kurdish People

After the Desert Storm victory, coalition forces provided humanitarian support to the Kurdish people of northern Iraq through Operation Provide Comfort. The operation presented a unique set of challenges for participating military units—and especially for the U.S. 18th Engineer Brigade.

Deployed from Karlsruhe, Germany in April of this year, the brigade was part of Joint Task Force Bravo (JTF-B)—responsible for overseeing operations in northern Iraq. The brigade was given responsibility for all engineering in the region, and was headquartered in Zakho (see map).

In turn, the brigade controlled all coalition separate engineer units in the region. These units included the 94th Engineer Combat Battalion (Heavy) (ECB(H)) (US), the 133rd Naval Mobile Construction Battalion (NMCB) (US), the 51st Field Squadron (United Kingdom) (UK), and the 11th Engineer Relief Battalion (Netherlands) (NL). The 94th and 133rd were deployed from Darmstadt, Germany and Rota, Spain, respectively. The Dutch unit was a composite battalion created specifically for Operation Provide Comfort, and included an engineer company, a medical company, and a staff company.

Elements of the Air Force 564th Civil Engineering Squadron (Prime Beef), Air Force 39th EOD flight, Army 72nd EOD Detachment, 524th Special Team Royal Engineers (STRE) (UK), and 6th Field Squadron (UK) rounded out the tactical organization of the brigade. Due to a shortage of lift assets, it took about a month from the arrival of the brigade headquarters until all units had arrived in Iraq. The brigade task force eventually reached a strength of about 2,000 personnel from three countries.

Only organic engineer platoons remained under the control of their parent units. These elements were primarily used to provide combat engineer support to their higher headquarters, but were called on from time to time by the brigade to augment scarce engineer resources as the mission dictated.

The urgency of the mission at hand transcended language barriers and interservice rivalries.

By Colonel Stephen A. Winsor and Major Stephen D. Austin

The Kurds had to be moved out of the mountains on the Turkish border, relocated to transient camps and/or their homes, and their health and well-being ensured. So, despite the diversity of units under the brigade's control, cooperation and a sense of purpose were the rule rather than the exception.

After setting up operations, the brigade prioritized several primary engineer missions. The first and most difficult was to provide engineer command and control. This would enable the brigade to manage the construction of sufficient camps to handle the expected flow of displaced Kurds. These camps were located primarily in the Zakho valley, but camps were also planned just east of Zakho near Suri, and to the south, just outside of Dihok.

The second mission was to provide sustainment engineering for coalition forces in northern Iraq. This was a demanding responsibility, considering that troop units from six countries had to be supported. As JTF-B became a division-sized force with a troop strength exceeding 15,000 personnel, engineer support became critical.

The third mission was to manage real estate allocation and use, primarily in the Kakho area, where the bulk of JTF-B forces were located. With limited space and a plethora of units, this was no easy task.

An additional "be prepared" mission called for the brigade to provide mobility, countermobility, and survivability engineering for coalition forces should the Iraqi Army initiate an attack from the south.

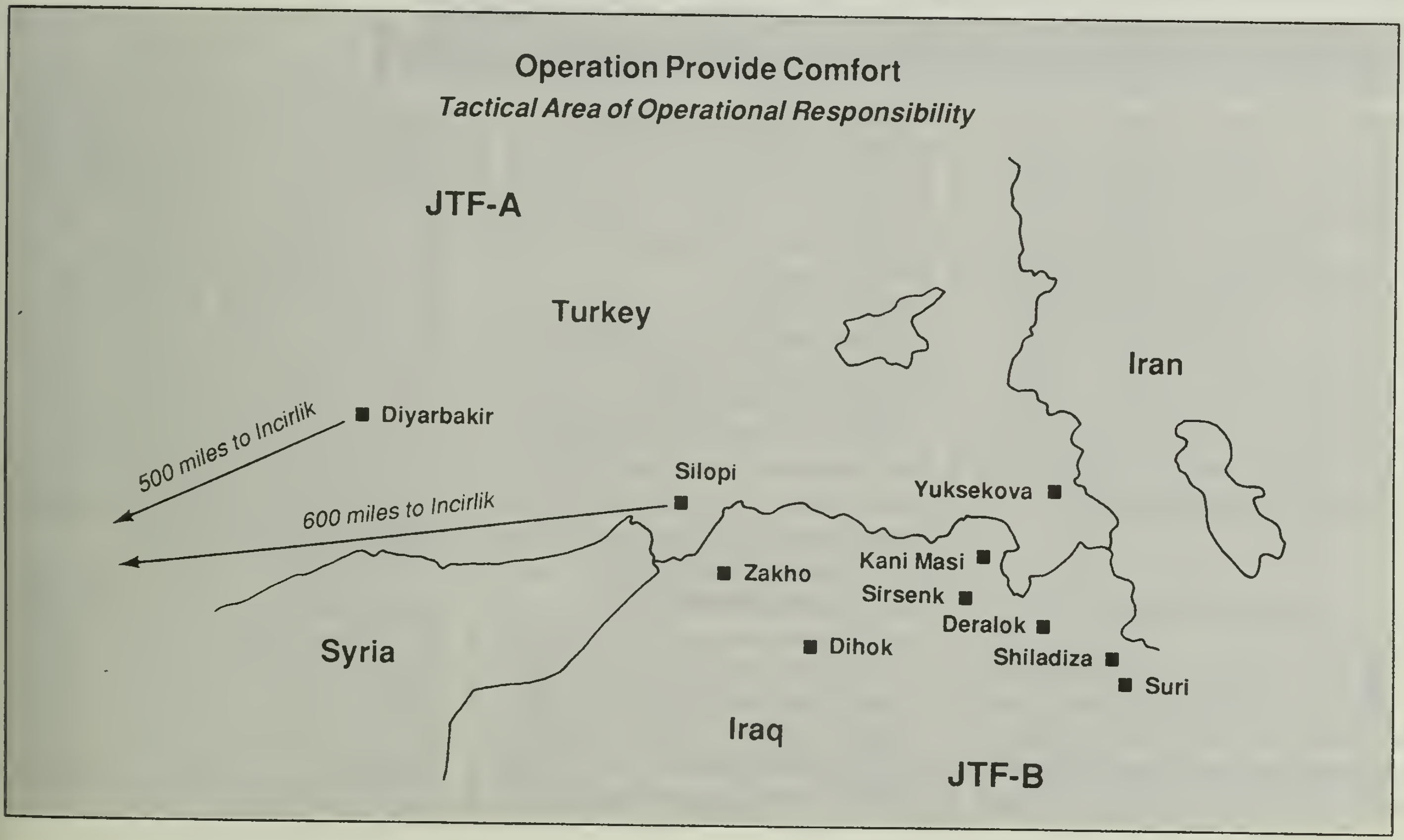
The humanitarian assistance mission was dynamic and evolved through several stages before the final concept emerged. All construction which supported the camps had to be adapted to the Kurdish lifestyle to ensure the facilities were accepted and used. From the start of the operation, professional relief experts advised us on important cultural and sanitary considerations for the Kurdish people.

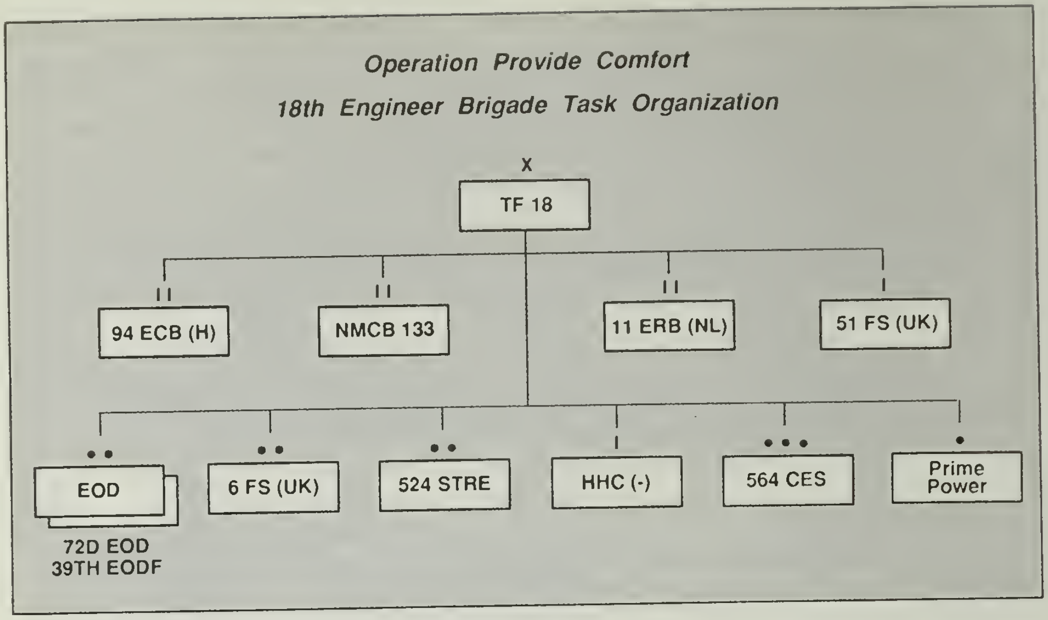
In response, the command devised five construction guidelines which were excellent benchmarks throughout the exercise. These guidelines directed that all infrastructure and construction be: adaptable to Kurdish culture, easily taken over by civilian relief organizations, temporary in nature, economical, and easily constructed.

Both cultural and religious customs had to be considered. Latrines, for instance, were designed to accommodate only one person at a time and were positioned to preclude the individual from turning his or her back to the east. While such restrictions made the construction projects less "efficient" from a purely engineering standpoint, they were well worth the effort when the Kurds moved in.

Originally, ten transient camps were planned, each capable of handling about 21,000 people. They were planned to be built in the Zakho valley area east of the city.

Each camp, covering about 1.5 square kilometers (km) was composed of a city center and five




Operation Provide Comfort

18th Engineer Brigade Task Organization

sub-communities of approximately 4,200 people each. The city center handled food warehousing, health care, administration, security, engineering, and logistics services. The sub-communities were further divided into villages, blocks and "zozans"—or basic building blocks of the Kurdish community.

The zozan was designed to hold 66 people in 12 tents. The tents were set in a rough square with 3 tents to a side. All tents faced inward to a common area. Three of the four corners of the zozan square contained latrines. The tents came from a variety of sources, ranging from American military general purpose (GP) smalls to desert Bedouin tents.

The progression from zozan to sub-community was simple. There were four zozans to each block and four blocks to each village. Finally, four villages comprised one sub-community.

Infrastructure

The brigade's responsibility for providing camp infrastructure required considerable coordination of resources and effort. The latrines, water system, and food warehouse facilities were contracted through TUSEG (The United States Army Engineer Group of the Europe District of the U. S. Army Corps of Engineers). Representatives of TUSEG worked with the construction management section of the brigade to provide quality assurance of contractor operations. TUSEG also assisted in coordinating with the United Nations High Commission for Refugees (UNHCR) and various non-government organizations (NGO). Among these was the International Relief Commission (IRC), which eventually took over operation of the transient camps.

The contractors used by the brigade were Turkish and all their materials were brought in from Turkey. One of the most important of these contracts was for the water systems. Each camp system had eleven 6,000-gallon tanks placed throughout the community with tapstands connected to each of the tanks. Initially, water was hauled from the wells to the tanks by military and contract trucks. Later, a contract was let for a permanent piping system between the wells and the water tanks. By the end of Operation Provide Comfort, permanent piping systems were constructed in two camps.

Another major contract was the fabrication and erection of latrines. While contractors were initially responsible for construction of the latrines, the heavy influx of displaced Kurds soon outdistanced the number of latrines. Troops were used to expedite construction, averting a potentially life-threatening health and sanitation problem.

Each camp required a minimum of 960 latrines, and latrines were constructed for three complete camps. The latrines generally consisted of an augered hole, plywood base, concrete baseplate, sheetmetal roof, door, walls, and a vent stack. Although not visually attractive, they served their purpose well.

Troop Construction

Many other missions were handled solely with troop construction. Soldiers surveyed the layout of the camp sites, constructed roads, erected tents, and put up contractor-procured fencing and lighting. Each camp required a road system of more than 9,000 meters. By the end of Operation Provide Comfort, complete road systems had been built for four camps, and a total of seven camps throughout northern Iraq had been surveyed. Fortunately, only three camps were ever occupied.

When the Kurds first started coming down from the mountains, one of the highest priority missions was the improvement of the road from Umzulu, Turkey to Kani Masi, Iraq. This was critical to the movement of over 130,000 people from the Cukurca and Umzulu

Top: **A Kurkish transient camp in the Zakho valley area. Each of the camps was capable of handling 21,000 people (U.S. Army photo).**

Right: **One of the food warehouses set up as an integral part of each transient camp's city center (U.S. Army photo).**

refugee camps back to their homes in Iraq. In fact, it was the only road from these two camps back into Iraq. The job was accomplished expeditiously by Seabees of the 133rd NMCB, who worked on more than 25 kilometers of unimproved roads for more than two weeks.

Humanitarian assistance took on many forms other than camp construction. These included construction of hospital administration areas, school furniture, construction and erection of playground equipment and the construction of storage facilities for CARE and the IRC. These projects were carried out as engineer assets became available. Over 300 sets of school furniture, including chairs, desks and tables, were built by the 18th Engineer Brigade. As the word got out that the engineers could provide quality construction, the non-governmental organizations kept carpenters busy with numerous requests. These products were destined not only for the transient camps, but for villages throughout northern Iraq.

Sustainment Engineering

The second primary mission for the brigade was sustainment engineering for all coalition forces in northern Iraq. This was no easy task, with a tactical area of operational responsibility exceeding an area 250km by 80km. While construction standards were austere and units used abandoned Iraqi Army facilities when possible, the task was still monumental.

Each individual unit required latrine and shower facilities. Protective berms for aircraft, fuel, and ammunition storage areas, roads, and logistics storage areas also needed to be constructed, repaired or maintained. Moreover, two large hospitals and multiple medical facilities required continual engineer support. As the higher priority tasks were accomplished, the brigade was also able to improve the quality of life for all soldiers by constructing numerous articles of miscellaneous furniture.

When tallied up, the brigade maintained over 225 kilometers of main supply routes (MSRs) and local highways for more than 45 days. It constructed over three kilometers of 10 to 15-foot-high POL and aircraft protective berms, and built numerous latrines, showers and other facilities. The brigade was also in the water supply business, as the 133rd NMCB and 51st Field Squadron (UK) contained organic water supply units.

Sirsenk Airfield

One of the brigade's high-profile sustainment engineering missions was returning Sirsenk Airfield to an operational status. Sirsenk Airfield was approximately 50 kilometers west of Zakho and—until Desert Storm—was under construction by Saddam Hussein's forces to service his palaces in the area. It was bombed by the coalition air forces and sustained heavy crater damage during the war.

The brigade tasked the Air Detachment of 133rd NMCB, augmented by an earthmoving platoon from the 94th ECB(H) to create a C130-capable airstrip from the remains of the airfield. This was accomplished in approximately 6 days. Abandoned Iraqi construction equipment at the airfield, particularly dozers, was used to augment scarce heavy engineer equipment. Twelve large craters and numerous smaller ones were filled and compacted to create an 80-foot by 5,000-foot airstrip.

Airfield repair operations also included laying geotextile fabric in two craters to preclude drainage problems. The fabric was flown in from existing stocks at Incirlik AFB, Turkey. This combat strip proved its worth, allowing airlift operations for more than 60 days, sometimes handling up to eight flights a day.

As resources became available, the brigade was also able to pursue a number of civil affairs assistance projects to aid the local Iraqi population. Most of these projects worked toward improving the electrical or water systems in the area.

Two Corps of Engineers prime power experts, called in from Saudi Arabia, were instrumental in providing power to the Zakho hospital. They repaired the hospital generator, which operated more than 45 days while domestic power was restored. This same two-man team, working with electrical experts from the 133rd NMCB and 524th Special Team Royal Engineers (STRE) (UK) were solely responsible for reestablishing domestic power to over half of the city of Dihok (population: 250,000-plus). Their efforts provided power to seven city water wells, the Dihok city hospital, and the Dihok dam, which provided water to many parts of the city. Ironically, the Iraqis initially did everything they could to stall the electrical team's efforts. But after seeing the results of their work, they did not want the team to leave Dihok.

Dihok

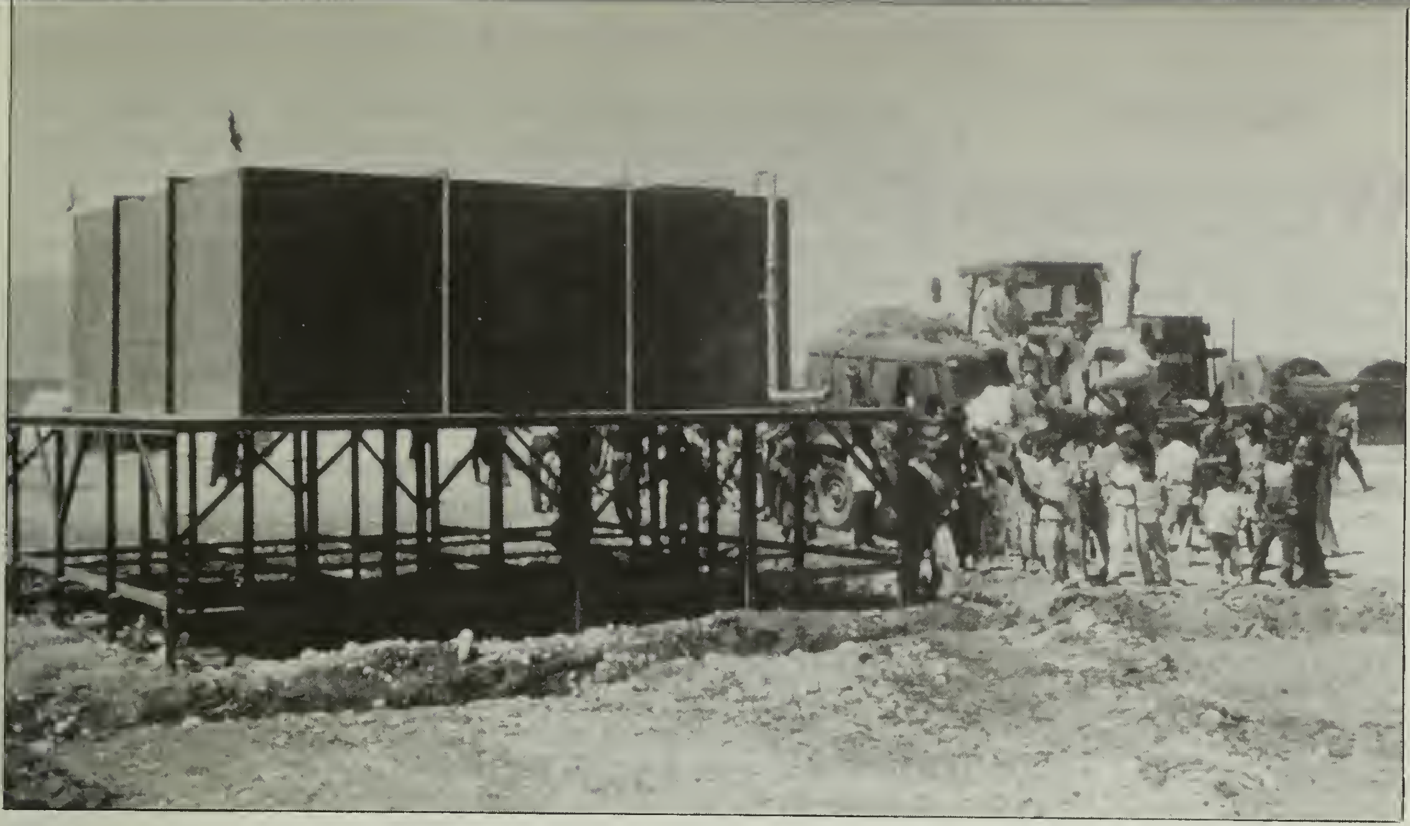
Engineer operations in the city of Dihok proved to be one of the most interesting and valuable contributions to the entire support mission. Dihok is the largest northern city with a substantially Kurdish population. As such, it holds great emotional significance for the Kurds. Many Kurds who lived in and around Dihok waited in camps for coalition forces to bring the city into the security zone.

But Dihok also held great political significance for the Iraqi government. The government indicated that it would not move Iraq military and police forces out and allow coalition forces into Dihok as it had done in Zakho and locations to the east. As negotiations stalled, the lack of a sense of security within the city stalled the return of displaced Kurds to their homes. Coalition negotiators finally convinced the Iraqi government that it would be in their best interest to accept a non-threatening assistance team made up of coalition soldiers with special skills to "help" them restore basic services to the city.

A team of approximately 100 soldiers, consisting of engineers, explosives specialists, medical personnel, civil affairs experts, and military police was allowed into Dihok to begin a very visible period of assistance. Seeing the coalition soldiers dispersed throughout the city convinced the Kurds that the city was safe, and they began returning to the city by the thousands each day. As the city came to life, the soldiers were replaced with a small UN security police force, along with private relief organizations. Because of the special skills they possessed and their very visible presence, the engineers and other soldiers on the team were able to accomplish what might have taken thousands of combat soldiers.

Water

Water was a constant problem and much effort was addressed to supplying the local population with safe and adequate supplies. Toward this end, four wells in the Zakho valley were put into service to supply the transient camps and the local population. These wells were activated primarily by bringing in new pumps and generators. The 133rd NMCB also accomplished a first for Iraq when they successfully drilled a 250-foot well in Deralok, providing 60 gallons of water per minute to coalition forces and local citizens.



Kurdish children gather around a water storage tank built by the engineers (U.S. Army photo).

The wells, along with siting and locating fourteen 6,000 gallon tanks throughout the sector, made a considerable impact on alleviating water problems in Kurdish settlements throughout northern Iraq.

Munitions

The unusual unit diversity within the brigade task force led to missions not usually encountered by the 18th. The 39th EOD flight, 72nd EOD Detachment, and EOD teams from the 11th EN BN (NL), removed and destroyed over 3 million pounds of Iraqi munitions while in northern Iraq. Confiscated munitions ran the gamut from small arms ammunition, rockets, grenades, and mines, to mortar rounds and large projectiles up to 152 millimeters (mm).

These munitions, manufactured in several countries, were strewn everywhere. Many times, coalition soldiers had to take items of ammunition from Kurdish children. Ammunition of every description was left in almost all positions formerly occupied by the Iraqi soldiers.

Minefields were also prevalent throughout the area and were a constant danger, but as little as possible was done about these obstacles to preclude risk to coalition personnel. Coalition forces were tasked with marking minefields, but mines were not removed unless they presented a direct hazard to coalition forces. Fortunately, mine neutralization proved to be necessary in only a few cases.

Combat Engineering

On at least one occasion, the brigade served as a combat engineer unit. The JTF-B commander was concerned about the possibility of an Iraqi attack as coalition forces expanded the sector south to Dihok. Accordingly, the brigade provided combat engineer planning and prepared for this contingency by task organizing elements of the 94th ECB(H), 133rd NMCB, and 51st Field Squadron (UK) into a provisional organization under the brigade S-3. This organization was prepared to support the 24th MEU and 3/325 Infantry by constructing obstacles and building fighting positions. Engineer platoons organic to the 3/325 and 24th MEU would support their own units in conjunction with brigade task force elements.

The construction of obstacles was complicated by the lack of munitions and the nature of the terrain. An obstacle trace was devised, consisting of hand-placed point minefields, short tank ditches and bridge destruction. The obstacles were sited on high-speed avenues of approach. Point minefields were necessarily small as the only mines available in the area were captured Iraqi mines. Because of the shortage of dozers, tank ditches were designed to be short and were sited only in the vicinity of roads. Lastly, since there were few bridges in the sector, destruction of identified bridges did not overtax critically short engineer assets and available demolitions. Road craters would have been ideal in many locations. They were planned but not executed for lack of suitable charges.

Observations

With all the challenges in Operation Provide Comfort, many valuable observations were noted. One that we seem to continually relearn is that engineers need to deploy very early—and in sufficient strength to do the job. Initially, only the Air Detachment of the 133rd NMCB and B company (minus heavy equipment) of the 94th ECB(H) were on the ground. Even these two companies would have made a tremendous difference and been more fully employed if they had arrived a week or more earlier. Eventually, the brigade built up enough strength to handle all missions.

However, during the critical early stages of the operation, more engineers were badly needed. In order to make this happen, better contingency engineer packages need to be developed. These packages must be capable of being quickly tailored to meet specific needs, be able to deploy rapidly by military aircraft, and be able to sustain and protect themselves for at least 30 days. Small dozers, SEEs (small emplacement excavators), graders, and forklifts are critical to these packages. The brigade is now in the process of developing such packages for future missions.

The mix of engineer forces is important. The organic combat engineer forces that arrived with the combat elements were not adequate to satisfy all the combat engineer missions. Although operations in northern Iraq were humanitarian in nature, mobility, countermobility, and survivability missions were very real. The 18th Engineer Brigade undertook the planning and execution of these missions, but lacked mine detection and clearing capability. For future contingency missions, a mix of engineer capabilities should be tailored to respond to possible engineer missions.

Our lack of local experience and the austere conditions around Zakho made the local contracting process both difficult and critical. The brigade learned very quickly that an efficient, on-site contracting capability is almost a necessity. We depended on the established Corps of Engineers apparatus, but the distance from Incirlik to the brigade was over 600 miles and less-than-desirable communications hindered the process.

A contracting cell, co-located with the brigade headquarters, would have greatly enhanced our ability to better tailor the contracts to the situation at hand and quickly locate and procure engineer construction materials. It is unrealistic to expect a contingency engineer force to move in and establish its own contracting capability. Locating a local expert with the engineer headquarters on the ground seems to be the answer.

Engineer materials were a problem. Class IV was slow to arrive and even upon arrival, high priority humanitarian needs in Iraq competed with low priority needs—such as tent floors— farther to the rear in the supply system. The brigade established a central construction material yard in Zakho to control all class IV in northern Iraq. Run by experts—the 6th Field Squadron (UK)—the yard worked flawlessly, but was at the whim of a slow and non-responsive supply system. Only a dedicated crew of contracting "expediters"—scroungers if you will—kept the brigade alive in terms of real-time mission accomplishment.

These actions should not have been necessary. Local-purchase authority is absolutely necessary for any engineer organization on a contingency mission. Elimination of the diversion of engineer material in the supply system can only be done by bringing it to the attention of the tactical commander.

Other problems encountered by the brigade came from splitting the brigade headquarters between Germany and Iraq. There were still four battalions working in Germany which could not be left to operate independently. This necessitated dividing each staff section in order to best support both operations. The headquarters, of course, is not structured or resourced to operate in this manner.

Difficulties arose from the almost exclusive "European" focus and mature-theater mission of the brigade. Equipment presumed to be adequate in the European environment—especially communications equipment, MHE, and haul assets—proved to be inadequate for operations in Iraq.

The Main Lesson

But the main lesson to be learned was that dedicated, well-trained, spirited engineers—regardless of their country or branch of service—adapt very well to the situation at hand and routinely perform miracles. If we did not know that before Operation Provide Comfort, we know it now.

Colonel Winsor is commander of the 18th Engineer Brigade. He previously served as commander of the 547th Engineer Combat Battalion, and executive officer of the 54th Engineer Combat Battalion. He is a graduate of Command and General Staff College and the Naval War College. He received his commission from the U.S. Military Academy. He is a registered professional engineer in Virginia.

Major Austin is S-3 plans officer for the 18th Engineer Brigade. He previously served as assistant resident engineer for the South Dakota District Office of the Corps of Engineers. He has also served as a company commander with the 82nd Engineer Combat Battalion. He is a graduate of Command and General Staff College. He was commissioned from the U.S. Military Academy. He is a registered professional engineer in Virginia.

What Are You Worth?

As the Army begins to build down, many in my yeargroup (1981) are feeling the anxiety of waiting two years for our promotion board. Many officers and noncommissioned officers (NCO) I know, especially those who "missed" the Gulf War, are wondering if they will survive the coming cuts. While Congress worries about taking a little more time to make the cuts, some of us just worry.

One day you may get the word, a quick personal meeting with your commander, closed door, somber: You were not selected for retention (reduction in force (RIF) scenario). Perhaps it's even more personal: You were passed over for promotion, not selected (very low selection rate scenario). A lot of good soldiers will hear words like those in the next few years. It's a shame, but how else can the Army cut 25 percent of its force? Somebody has to go.

So now what? How do you react? What is the "right thing" to do? Let me offer some suggestions and propose a reality check for your perspective.

Assess. During the eight, ten, twelve, or more years spent serving your country, you have learned a lot. What is in your head is of great value. What is in your heart is of even greater value. Professional (mid-career) officers and noncommissioned officers are leaders. They are responsible for the lives, training, discipline, care, and development of people.

You may not be a Dale Carnegie graduate, but you are a people person. You get things done through the direction and leadership you provide to others. That skill and experience are of enormous value. Just because the Army has a smaller need does not diminish your inherent value. Pick up your chin and think for a moment.

Prior to active duty I was a project engineer for a small, heavy highway construction firm. Let me tell you what most employers really want: capable, flexible, trainable, dependable people who are honest, hardworking, and willing to accept and bear responsibility. They want mature people who are ready to work, prepared to deal with life and get the job done. They want men and women who know and understand people and know how to direct, lead, and motivate them. And, they want people who are at least as interested in the company as they are in themselves. Those descriptions sound like a good company commander or top-notch NCO to me. If you take a close look at your experiences with people, getting tough jobs done, going the extra mile for someone or for the mission, you begin to get the picture. You probably are worth much more than you thought.

Accept. The experiences of being fired once and laid off once taught me a basic lesson: Other people do not dictate my personal self-esteem. The Army's need to drawdown should not dictate your self-esteem either. When you go job hunting, some places won't want you, and others may not need you. Life is often that way. But remember that the Army gave you another important asset: an understanding of justice, human dignity, and personal rights.

The work environment in the private sector may differ greatly from that in the Army. Not every business is as color or gender blind as the Army. Not every boss rates on performance and merit alone, and promotions sometimes go to less qualified people. The U.S. Army holds the unique distinction of living out the promises of our constitution for every service member. Such is not always the case on the "outside."

This is where you can make the most difference. Take the lessons of personal integrity, honesty, fairness, and justice with you. Of all the values you have learned, those are the most important.

Act. Many good soldiers will take a multitude of valuable skills into the private sector in the next few years. If you are invited to take up another occupation, view it as just another opportunity in life. By no means view it as a measure of your value as a person or a soldier. Get ready for it. Deal with it, and then get on with your life. Take the pride and values of the U.S. Army into the private sector and show the people who work with you and for you how good you really are.

There is a trade deficit to erase, products to improve, services to fine tune, new technologies to develop, and another generation of young Americans to educate. We have drugs to fight, crime to control, people who need help. Who can do these jobs better than a soldier, than an Engineer soldier!

CPT Brannon is an analyst for the U.S. Army Engineer School. Previous assignments include platoon leader, DEH operations and executive officer, assistant S-3, and company commander. CPT Brannon is a registered professional engineer in Texas.

THE BRIGADE DELIBERATE BREACH

By Major Greg S. Kuhr and Major John F. Antal

For units undergoing Desert Storm preparation at the National Training Center (NTC), the greatest challenge was breaching Iraqi-style complex obstacles.

The obstacle developed at the NTC was about 500 meters (m) in depth. It consisted of a belt of buried anti-tank and anti-personnel mines, supplemented by a tank ditch and several wire obstacles. The infantry trench was approximately 200m behind the last minefield. The whole obstacle was supported by fighting positions for tanks and anti-tank weapon systems. Such a formidable defense, when properly employed by the enemy, can be penetrated only by a well orchestrated deliberate breaching effort.

This article describes how a brigade, as part of a heavy division deliberate attack, can synchronize a deliberate breach of a complex obstacle and trench line. While the model used in this study is based on Iraqi doctrine, the principles apply to all deliberate breaching operations.

The primary reference for this article is FM 90-13-1, *Combined Arms Breaching Operations.*[1] This manual identifies four fundamentals used for achieving synchronization during deliberate breaching operations:

- Detailed reverse planning.
- Clear sub-unit instructions.
- Effective command and control.
- Well rehearsed forces.

Reverse Planning

Planning for a deliberate breach begins with a thorough mission analysis. The commander and his staff must determine the following:

- Purpose of the higher headquarters' mission.
- Intent of commanders two echelons up.
- Specified, implied and essential tasks to be performed.
- Assets available.
- Constraints and restrictions.
- Degree of risk involved.
- Analysis of available time.

After completing the mission analysis, the commander should give a warning order, and give the staff his guidance. The staff then develops courses of action, analyzes each one, and presents them to the commander. After he makes his decision, the order is prepared and issued.

The reverse planning technique assists the staff during this process. Reverse planning will "ensure that actions at the obstacle support actions on the objective."[2] This technique requires that the commander and his staff have a full understanding of the organizations that are required for breaching operations.

Breaching Organization

Once the brigade commander has determined (by analyzing relative force ratios) that the breaching operation is beyond the capabilities of a single or reinforced battalion task force, he must task organize to conduct a brigade deliberate breach. The brigade should give specific support, breach and assault roles to appropriate subordinate task forces. Forces are allocated for each mission using a force ratio analysis.

The Support Force. The support force mission should be assigned to an armor heavy task force. The mission of the support force is to destroy the enemy's ability to interfere with the obstacle reduction operation. It does this by winning the direct fire battle over the breaching area, controlling

An armor unit practices breaching operations at the NTC. Complex obstacles, when properly employed by the enemy, can be penetrated only by a well orchestrated effort (U.S. Army photo).

indirect suppressive fires, and obscuring the breach site from enemy observation. The support force also secures the area of penetration with fire prior to deployment of the breach force. (While securing the breach site by infiltrating into the trench is an option, it is generally not feasible because of the depth and complexity of such obstacles).

The support force should deploy into an attack-by-fire position that is within the range of its direct fire suppressive weapons. For tanks and infantry fighting vehicles, this means that the support force must be within 1,500m to 1,800m of the trench line. To accomplish this, the support force must attack using a "creeping" overwatch from successive attack-by-fire positions starting at 3,000m. Once the breach force is deployed, the support force must continue to isolate the breach site from enemy fires.

The Breach Force. The breach force mission should be assigned to a balanced or infantry-heavy task force. The majority of the brigade's breaching equipment should be assigned to this force. The mission of this task force is to provide secure passage lanes for the brigade assault force and clear the enemy trench line. The force must be a combined arms team capable of executing all of the breaching fundamentals: suppression, obscuration, security and reduction (SOSR). When faced with a complex obstacle defended by an infantry trench line, the breach force is organized into the following sub-units:

- A support team to provide local suppression.
- A breach team to reduce the obstacle.
- An assault team to secure the breach site by attacking the enemy in the trench line, and blocking possible enemy armored counterattacks.

Depending on the availability of forces, the task force may designate company teams to play more than one role in the breaching operation. For example, a portion of the support team may be designated as an assault team once a breach lane is established. (To avoid confusion in terms, refer to all of the breach force's subunits as teams.)

The breach team is built around breaching assets (armor and engineer). Armored breaching assets (mine-roller tanks, mine-plow tanks, combat engineer vehicles, armored vehicle launched bridges, and armored combat earthmovers) are critical because of their survivability. Explosive breaching using mine clearing line charges (MICLICs), and manual breaching done by sappers and designated infantry units, complement the armored breach. The assault team should be infantry-heavy in order to clear a defended trench line. The support team should be balanced with armor and mechanized infantry in order to suppress and destroy all of the enemy's direct fire systems.

The Assault Force. The assault force is either balanced or infantry heavy. The brigade may designate one task force as the breach/assault force if the brigade has only two task forces. The mission of the assault force is to pass through the breach lanes and seize defensible terrain 1,000m to 1,500m on the enemy side of the penetration. The assault force then defends against enemy counterattacks, giving the brigade time to pass forward the support force or other follow-on forces. These follow-on forces continue on to seize the brigade objective.

Other task forces should be designated by division headquarters to exploit brigade penetrations of the enemy obstacle belt. These forces should have an on-order mission to be the division main effort once a brigade breach site is secured. These follow-on forces maintain the tempo of the attack by passing through the breach and seizing the division objective.

Reverse Planning Sequence

Deliberate breach planning should take place in the following order:

(1) Actions on the objective: The "who, what, where and when" must be determined for the far side of the enemy obstacle and trench line. This will focus the size, composition and missions of the assault force and the number of breaching lanes required to support it.

(2) Identify potential enemy vulnerabilities: A METT-T (mission, enemy, terrain, troops available, and time) analysis, based on the situation template, should be conducted to determine where the enemy may be vulnerable to attack. Typical opportunities include sites lacking protection of the enemy's mobile reserves, enemy positions lacking adjacent unit supporting fires, seams between units, and defensive positions supported by weak obstacle systems.

(3) Select breach sites: Primary and alternate sites are planned, then finalized after considering the results of silent breach teams, direct reconnaissance, or the support force commander's observations. The brigade must allocate sufficient company/teams to the breaching task force to clear lanes through the obstacle belt, fight and win the trench battle, and hold the breach site until the assault force can pass through. The breach force should organize its company/teams into breach, support and assault teams.

(4) Determine support force requirements: The support force is balanced with long-range anti-tank systems and infantry weapons that will enable it to win the direct fire battle at the breach site. The force should use a combination of tank fires and heavy machine gun fire to suppress enemy infantry in the trench system. The same fires will also isolate the breach sites once the breach force moves forward to conduct the breach.

(5) Development of scheme of maneuver: Commanders and staffs develop task organizations, unit missions, and other plans to support the requirements identified above.

Clear Subunit Instructions

Subunit commanders must understand exactly what is expected of their forces. If the support force does not win the direct fire battle over the point of penetration, the breach force will be jeopardized. Likewise, if the assault force is committed prior to the establishment of secure lanes, it could dissipate its combat power by having to fight through the obstacle lanes. Each subordinate commander must understand the interdependence of the breach, support and assault forces (and teams). They must understand each force's mission and how each successful mission develops the commander's decision making. Clear subunit instructions include the following:

Phase	***Co-located Command Groups***
1. Movement to the obstacle	Brigade command group and support force commander co-locate in vicinity of support force's attack-by-fire position.
2. Breach of the obstacle	Brigade command group and breach force commander co-locate to observe breach lanes.
3. Assault the defending enemy	Brigade command group accompanies assault force commander through the obstacle.
4. Continue the attack	Brigade command group accompanies the main effort.

These instructions must define the measure of success. For example, the support force is successful when the enemy can no longer place effective anti-tank fires on the breach sites because of destruction, suppression or obscuration. The breach force is successful when it has at least one secure lane through the enemy obstacle belt and has cleared the trench line in the near vicinity of the lane. The assault force is successful when it has destroyed the enemy's ability to place effective anti-tank fires on the intermediate objective on the far side of the obstacle.

The instructions must limit the responsibility of each subunit. The support force's suppression and obscuration mission should be limited to a specific breaching area. This enables the force to achieve sufficient mass to overwhelm the enemy's direct fire systems at the breach point. The breach force should be limited to clearing two lanes—the obstacle belt and the trench line—all within a well defined breach objective. The assault force should be limited to racing through the cleared lane and seizing a defensible terrain feature on the far side of the enemy trench line.

Lastly, the subunit instructions must clearly address the timing of the operation. This timing is determined more by events than by designated times. The breach operation must be quick, thereby limiting the force's exposure to enemy fires. The plan must address the timing of obscuration fires to preclude interference with suppressive fires. The breach and assault forces must be committed as early as possible, but not before the enemy's antitank fires are rendered ineffective at the breach site.

Effective Command and Control

Command. Effective command is critical to successful breaching operations. For a deliberate breaching operation, the commander must be far enough forward to see the breach sites. His command organization can play a vital role in this effort.

Field Manual 71-3, *The Armored and Mechanized Infantry Brigade,* stipulates that "the command group moves to a position that allows the commander to observe the battlefield, issue appropriate orders at critical times, and influence the battle with his personal presence."[3] For a brigade deliberate breach, that position is clearly one that gives him a good view of the planned breach site. Additionally, since this operation involves several units passing through each other, the co-location of command groups is critical. Here is the recommended co-location of command groups for each phase:

Depending on the location of the task force commander, the task force tactical operations center (TOC) may substitute for the task force command group. Terrain, communications and security must also be considered when deciding the best way to co-locate command groups.

While the brigade command group is co-located with the task force command groups, the brigade tactical command post (TAC) has four primary missions:

- Assist in the implementation of the commander's decisions.
- Serve as a backup should the brigade command group become ineffective.
- Control movement of units into the crossing area.
- Continue to synchronize combat operations, combat support, and combat service support for the close fight.

Traffic Control. The crossing area should be defined by release lines on each side of the obstacle. The crossing area is initially limited to the friendly side, and is extended as the assault force secures the far side. A far side release line should be planned to provide sufficient space for the assaulting task forces to deploy into attack formations.

Until the brigade has secured its objective, it must manage unit movement into the crossing area and across the obstacle. Movement control is passed to the brigade main command post prior to passage of the battalion task force field trains or follow-on brigades. Before the main command post can accept control of the crossing area, it must be in a position to effectively control the area and communicate with units.

During the first three phases of the operation, brigade main command post missions include executing the deep operation, tracking the close fight, coordinating combat support and combat service support requirements, and planning future operations. When the objective is secured, control of crossing operations for the remainder of the brigade should pass from the brigade TAC to the main command post.

A brigade crossing plan must be developed to control this part of the operation. The brigade S-4, assisted by the MP platoon leader, can organize a temporary traffic control cell at the brigade TAC to control movement through the crossing area. Once control is passed to the brigade main, this traffic control cell can relocate to the main command post.

The brigade commander should designate an officer, initially the brigade S-3, then the XO, to control the movement of forces through the crossing area. The brigade plan should detail the transfer of obstacle lane control from the breach force to the crossing area commander. This delegation of responsibility to a crossing area commander frees the brigade commander to concentrate on forward battlefield leadership. The crossing area commander controls:

- Movement and positioning of all elements transiting or occupying positions within the crossing area.
- Security elements (i.e., maneuver, air defense) at crossing sites.
- Support forces such as engineers, military police, and chemical units within the crossing area.

If the brigade is supported by an engineer

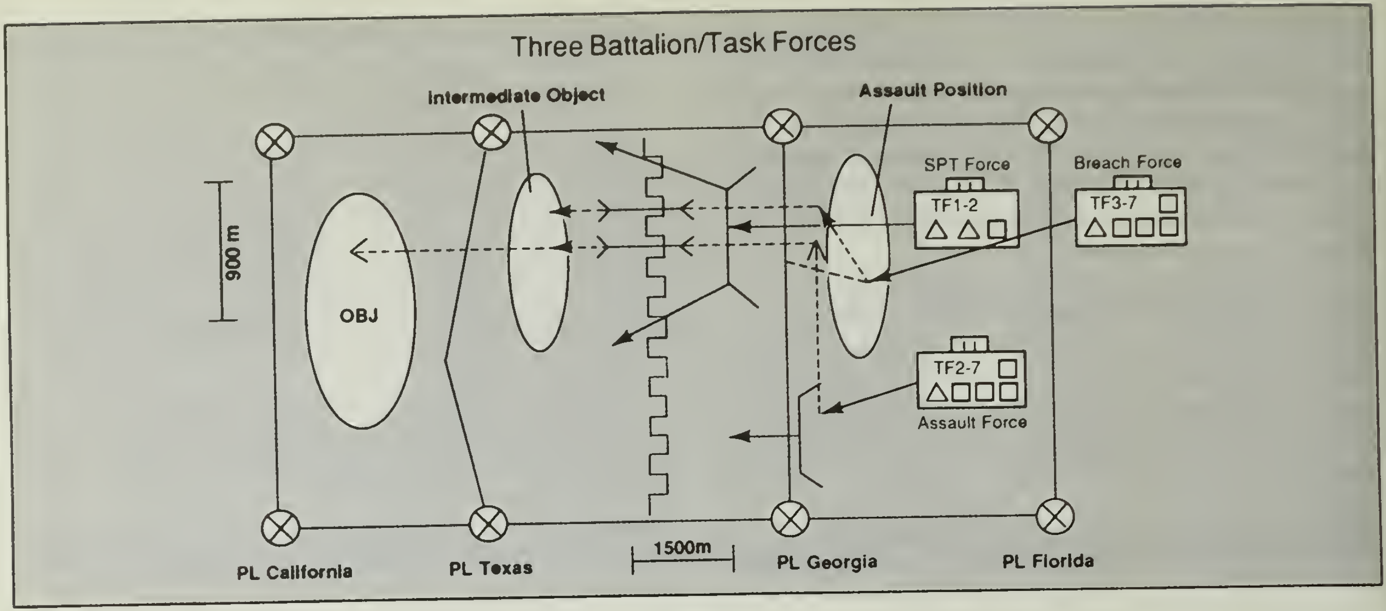


Figure 1

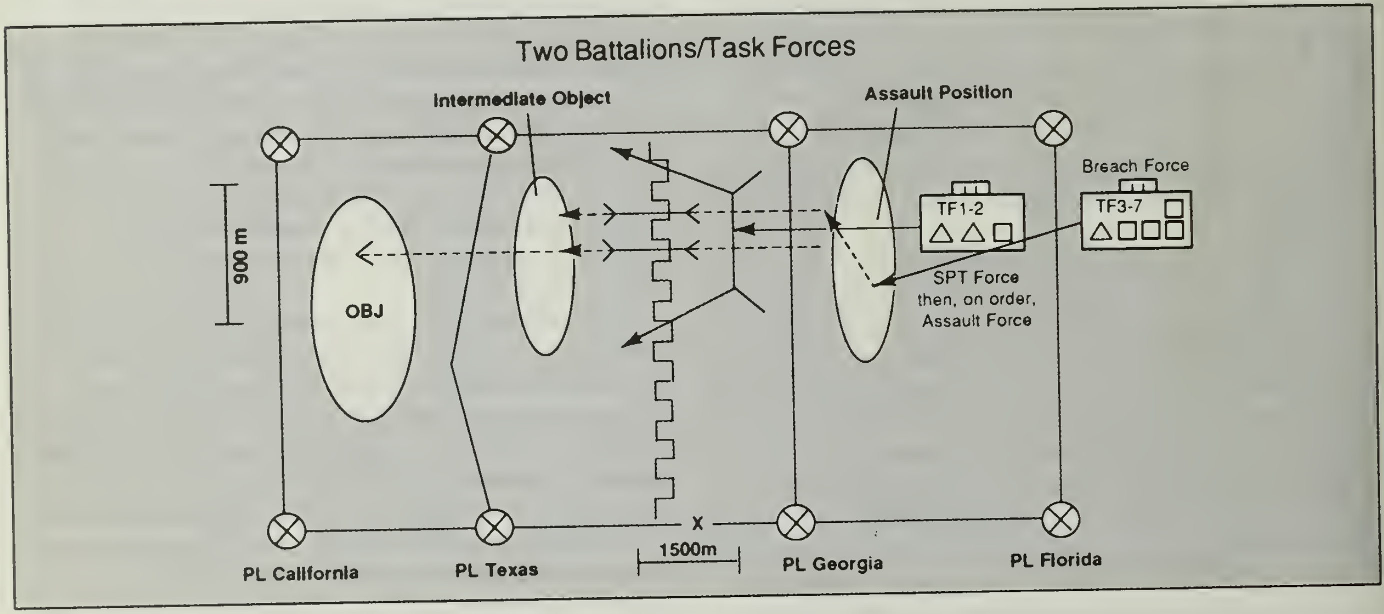


Figure 2

battalion, the engineer battalion commander should be designated as the crossing area engineer. He reports directly to the crossing area commander and is responsible for:

- Developing an engineer support plan, which recommends the combined arms battle drills needed to reduce the obstacle, allocation of armor and engineer breaching equipment, lane marking, and plans for improving/increasing assault lanes.
- Tracking the progress of obstacle reduction and advising the commander when changes in the plan are needed.
- (On behalf of the crossing area commander), assuming control of breach sites from the breach force commander as soon as possible after the sites are secured. Duties include keeping the lanes open, improving the lanes, and advising the crossing area commander of their condition.

Initially, the breach force is responsible for traffic control through the breach sites. The breach force must designate a breach site commander for each lane to control movement through the lanes. Site commanders should be company executive officers or platoon leaders whose responsibilities include:

- Maintaining cleared and well marked lanes.
- Establishing traffic control posts (TCPs) to guide units through the lanes.
- Reporting any lane closures to the breach

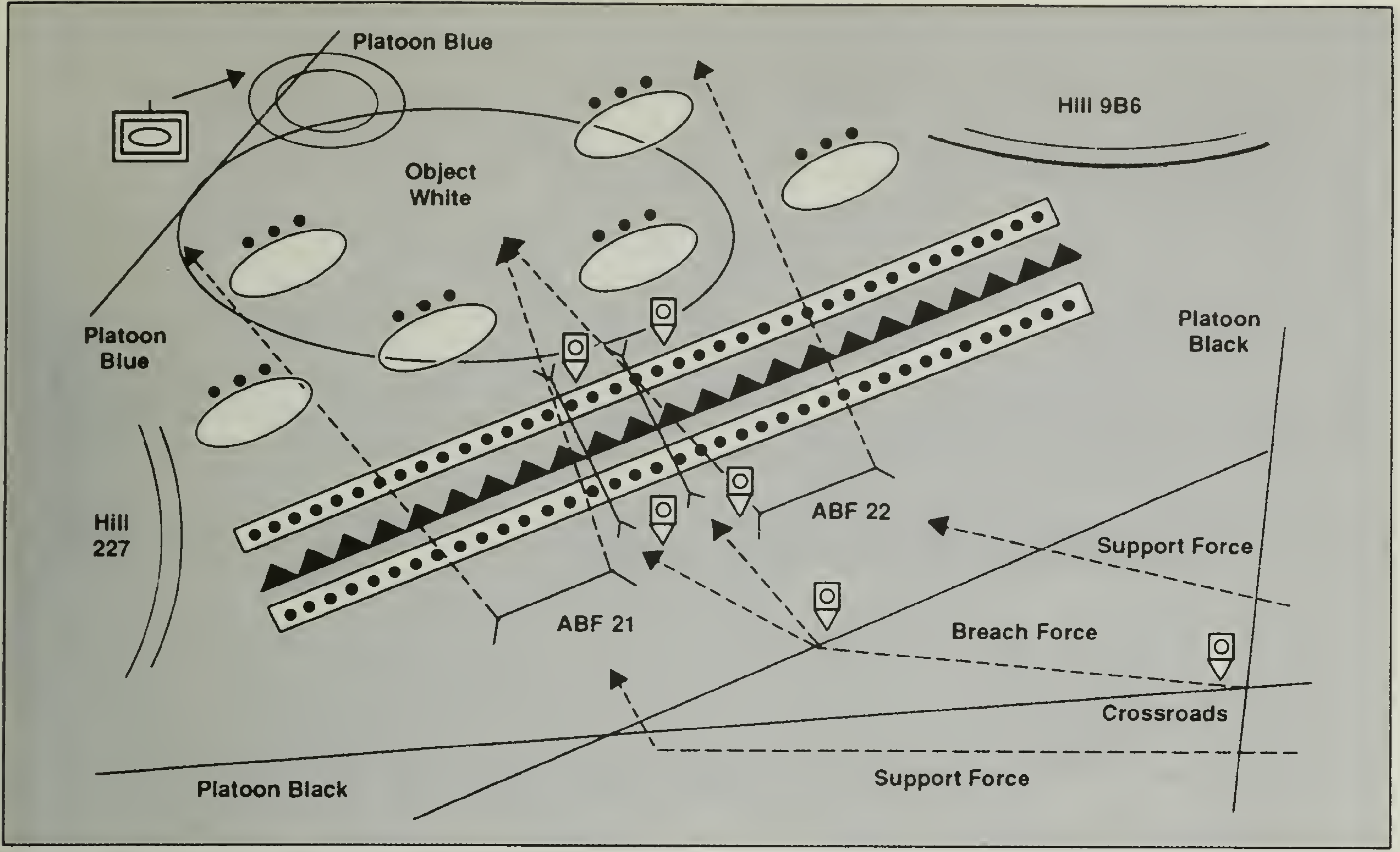


Figure 3

team commander (who in turn reports to the breach force commander).

The crossing area engineer should assume control of the breach sites as early as possible in order to begin lane improvements. Military police should quickly assume traffic control responsibilities from the breach force to facilitate an increase in the number of TCPs and to improve necessary route markings. Once relieved of these duties, the breach force can consolidate and prepare for follow-on missions.

Graphic Control Measures. Graphic control measures are established to facilitate cooperation between units without imposing unnecessary restrictions on the freedom of subordinate unit leaders. The minimum graphic control measures can be displayed three ways: the brigade operations overlay showing the overall brigade concept, a large-scale sketch to graphically portray actions at the obstacle, and a movement control overlay for traffic control within the brigade zone. Here are some examples of each of these:

Figures 1 and 2 show the minimum information to include on the brigade operations overlay:

- A direction of attack or axis of advance from the assembly area to the obstacle and beyond for the support, breach and assault forces.
- Location of assault positions where the assault force or other task forces will locate prior to commitment through the obstacle lanes.
- Primary planned breach lanes.
- Location of the support force attack-by-fire positions, with arrows extending over the range and direction of the direct fire systems.
- Intermediate and final objectives for the assault force and for any follow-on task forces.
- Phase lines and release lines.

If the brigade has a contingency plan to attack in a different location, the same graphics are required, but are drawn with dashed lines.

Figure 3 depicts the brigade's plan for actions at the obstacle. This is accomplished with a sketch map of the obstacle area. It's not possible to show this level of detail on a 1:50,000 overlay. At a minimum, the sketch should have the following information:

- Approximate locations of recognizable terrain features in the area.
- Location of enemy platoons in the main defensive belt and any reserve forces which could interfere with the breaching operation.
- Planned breach lanes.
- Support force attack-by-fire (ABF) positions, with arrows showing the range and direction

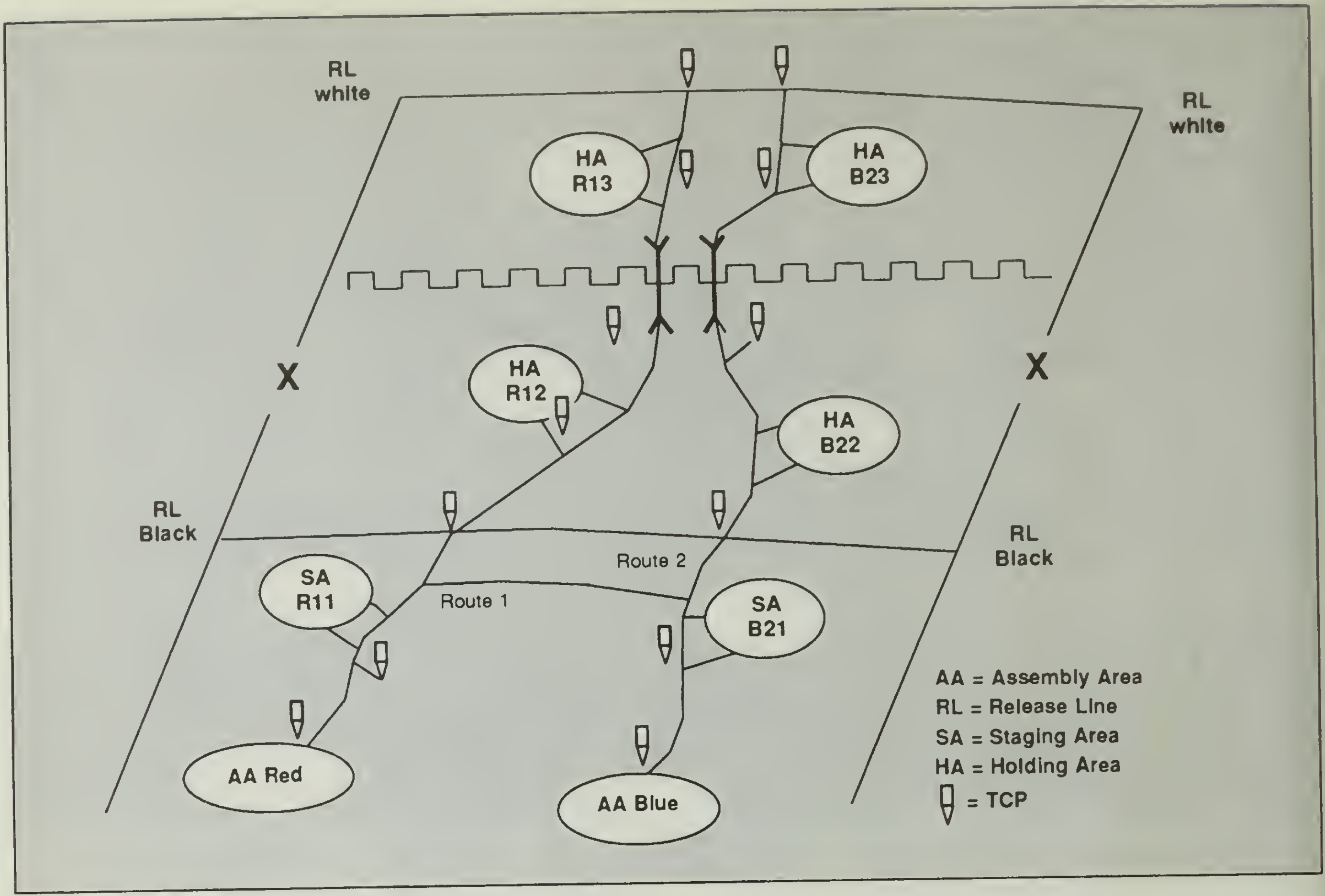


Figure 4

of suppressive fires.

- Routes for the support, breach and assault forces, to and through the obstacle.
- All objectives for the breach elements.
- Location of planned TCPs.
- Phase lines and release lines.

Figure 4 shows a movement control plan through the brigade's zone. As a minimum, this 1:50,000 overlay should have routes, holding and staging areas, phase lines and/or release lines, TCPs, and initial assembly areas.

Additionally, the brigade must identify designated routes, near and far signals to guide units to the lanes, and lane limits. Initial markings must be placed rapidly and should be improved and maintained as soon as the situation permits.

Control measures are also used to maximize the effectiveness of direct and indirect fires in support of maneuver and to reduce the possibility of fratricide. The brigade deliberate breach plan must include the following control measures for fires:

- Priority of fires. Who has it during each phase, who will decide to change it, and under what criteria?
- Coordinated fire line (CFL). Brigade CFLs will be used to protect units conducting forward passage of lines. These CFLs should be included on the operations overlay. The plan must note when the CFL changes, and who makes that decision.
- Hand-over line. The hand-over line will identify at what point the assault force takes over responsibility for the direct fire battle. It will be identified on the brigade operations overlay as a phase line, and can coincide with the far side release line.
- Target reference point (TRP). The brigade should have a standard methodology for designating TRPs. Subordinate unit commanders must coordinate the specific placement of TRPs to ensure that their fires are supportive.
- Smoke. Obscuration is a critical component of the breach. Too much or too little smoke can hinder the breaching effort. Smoke must be carefully controlled and coordinated to ensure that it supports the breaching effort. The chemical officer, fire support officer, brigade S-3, and engineer are the key planners. When planning smoke, consider the following:

- designate smoke targets for indirect fire systems, and use smoke generators for smoke objectives.
- identify who controls the smoke.
- coordinate the delivery systems (artillery, mortars, generators, vehicle engine exhaust smoke systems).
- determine effects of weather.

Well-Rehearsed Force

The purpose of a combat rehearsal is to improve agility, ensure synchronization, foster initiative, improve the depth of the force, and reinforce the scheme of maneuver and fire plan.

Rehearsals should "identify problem areas and contingency actions, determine movement reaction times, enhance coordination and refine the plan."[4] Rehearsals should be conducted for "actions critical to the accomplishment of the mission to ensure the unit can accomplish these actions given its state of training, the orders issued, and the terrain and weather conditions expected."[5]

When conducting a rehearsal, the commander should emphasize key events that trigger friendly actions. Rehearse both fire support and maneuver actions. The rehearsal becomes a tool that the commander can use to reinforce understanding of the plan, and help subordinate commanders visualize his intent. This assists subordinates in understanding what they are to do when the battle does not go according to plan.

The two essential ingredients of a brigade rehearsal are training down to the company commander level and carefully reviewing the details of the operation. It's recommended that the brigade conduct a minimum of two rehearsals. The first is a key leader rehearsal with a walk-through on a terrain model. The second is a full-scale, drive-through rehearsal which includes the company commanders. The brigade staff must prepare for the rehearsals by developing a script that describes the sequence of actions. An action-reaction format should be used, with the S-2 acting in the role of the enemy. While rehearsal techniques are beyond the scope of this article, engineer leaders should pursue combat rehearsals as a means of improving synchronization.

Conclusion

The Army must be able to bust through complex obstacle systems. For years, in-stride breaching techniques have been emphasized as a way of maintaining momentum and the initiative.

However, when an in-stride breach fails, or analysis of the force ratios confirms an enemy situation is beyond the capability of a subordinate unit[6], a deliberate breach must be conducted.

The four fundamentals outlined in this article will give the engineer officer a solid foundation for successful breaching operations. Detailed reverse planning focuses the force on mission accomplishment. Clear subunit instructions and effective command and control are essential to coordinating the actions of the support, breach, and assault forces—thus minimizing casualties. Lastly, a well-rehearsed force will have the agility to adapt to unexpected battlefield conditions.

By following these breaching fundamentals, engineer leaders and maneuver commanders can place combat power at the decisive point, and maximize their chances for a successful brigade deliberate breach.

Major Kuhr is S-3 of the 2nd Engineer Battalion. During Desert Shield/Desert Storm operations, he served as Senior Brigade Engineer Trainer for the NTC. He has also served as a company commander. He is a graduate of Command and General Staff College, and received his commission from West Point.

Major Antal, an armor officer, is XO of the NTC's Operations Group. He previously served as the NTC's brigade S-3 trainer. Other assignments include S-3 for for the 272nd Armor Battalion, S-3 for the 2-8 Cavalry, and company commander for both the 332nd Armor Battalion, and the 172nd Armor Battalion. He is a graduate of Command and General Staff College, where he earned a master's degree in military science. He received his commission from West Point.

Notes:

[1] Department of the Army, Field Manual 90-13-1, Combined Arms Breaching Operations. (Washington: U.S. Army, 28 February 1991).

[2] Ibid, pp. 2-7.

[3] Department of the Army, Field Manual 71-3, The Armored and Mechanized Infantry Brigade. (Washington: U.S. Army, May 1988), p. 2-5.

[4] Department of the Army, Field Manual 71-2, The Tank and Mechanized Infantry Battalion Task Force. (Washington: U.S. Government Printing Office, September, 1988), p. 2-21, 2-22.

[5] Department of the Army, Field Manual 71-1, The Tank and Mechanized Infantry Company Team. (Washington: U.S. Government Printing Office, September, 1988) p. 2-14.

[6] Department of the Army, Field Manual 90-13-1, Combined Arms Breaching Operations. (Washington: U.S. Army, 28 February, 1991), p. 4-1.

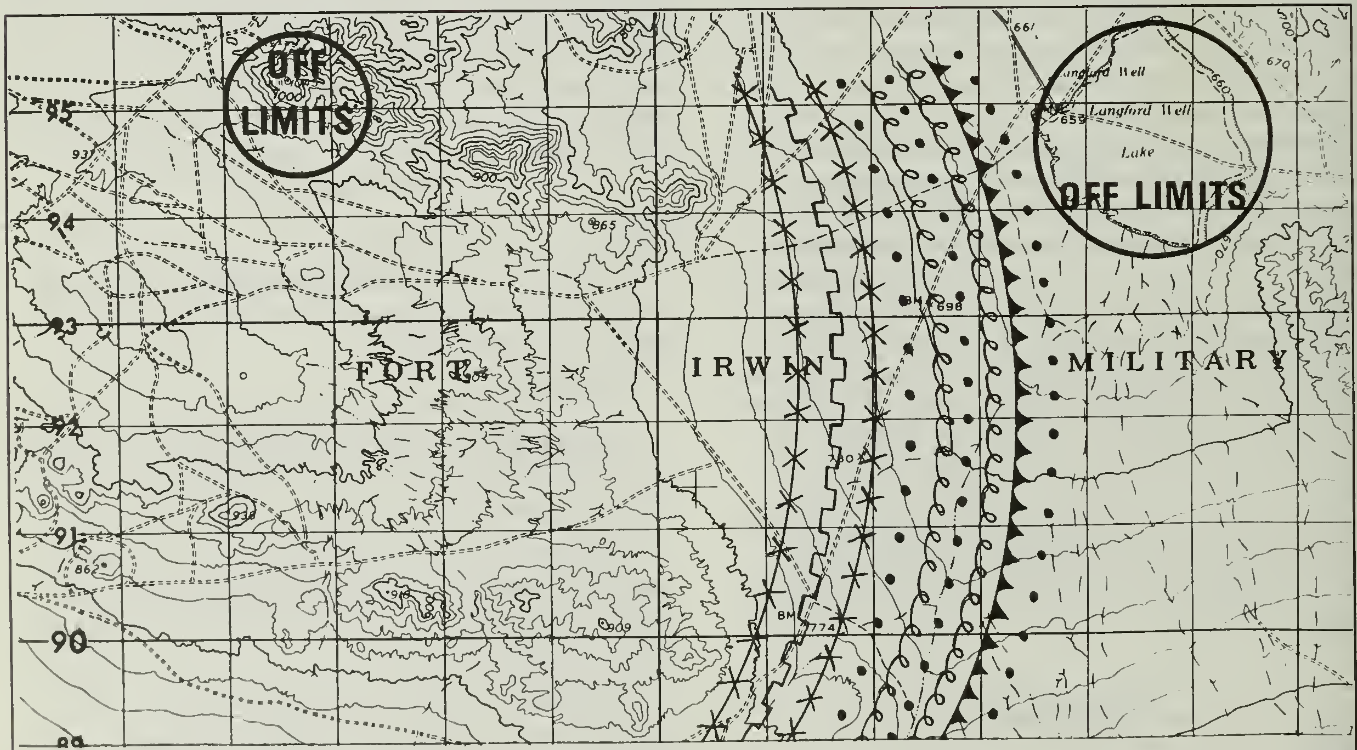
Constructing Iraqi-Style Obstacles at the NTC

Before Operation Desert Storm, the Iraqi Army possessed a formidable combat engineer force. These engineers had performed remarkably well during the eight-year Iran-Iraq War, emplacing millions of mines, diverting rivers to create obstacles, constructing hundreds of miles of combat roads, and building intricate defensive obstacles. The Iraqis did just as well in Kuwait—at least initially—where they constructed extensive obstacle belts along the border with Saudi Arabia.

The Mission

To familiarize mobilized Reserve Component forces with Iraqi-style obstacles, the 14th Combat Engineer Battalion (Corps) at Fort Ord was ordered to the National Training Center (NTC) at Fort Irwin in late November 1990. There, the battalion was given the mission of replicating the obstacles being built in Kuwait by the Iraqis.

The 14th served as a supporting engineer unit to the NTC's 177th Armor Brigade (OPFOR) (Opposing Force). During peace-time training rotations, the 177th plays the part of the mythical "Krasnovian Army," which fights with Soviet equipment and tactics. During preparations for Desert Storm, however, the 177th became the "Samaran Army," which mimicked Iraqi fighting forces. This part of the transition was relatively easy, because Iraqi military doctrine and equipment largely paralleled those of the Soviet Union and the now-defunct Warsaw Pact. The most difficult part of the "Samaran" mission turned out to be combat engineering.



Facts:

6.2 km of anti-tank ditch
9.6 km of trench systems
12 km of cattle fence
12 km of triple standard concertina
16 hull down positions

Obstacle 14: Largest obstacle ever constructed at NTC, 5-17 December 1990

By Captain Thomas E. Sawyer

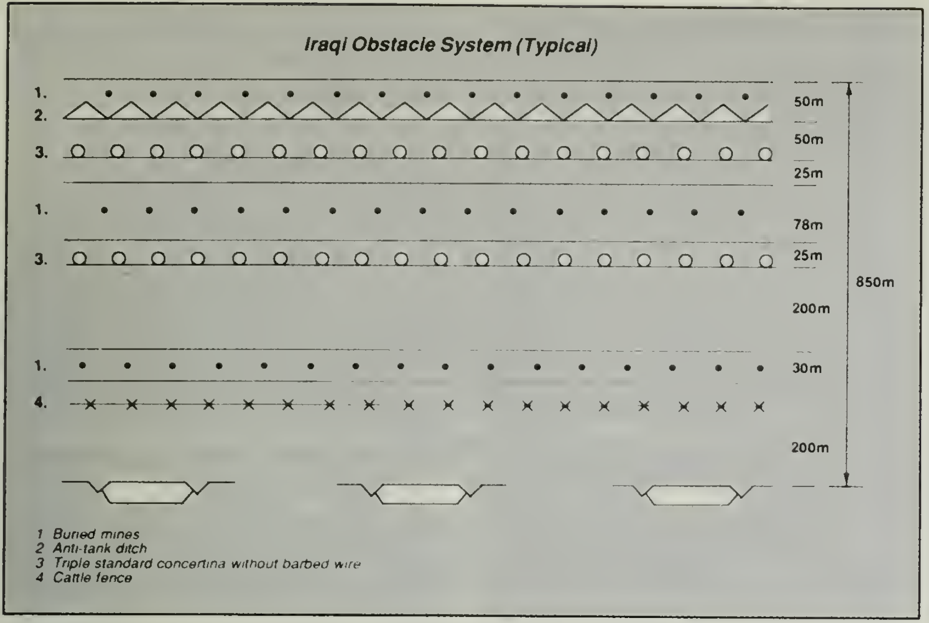


Figure 1

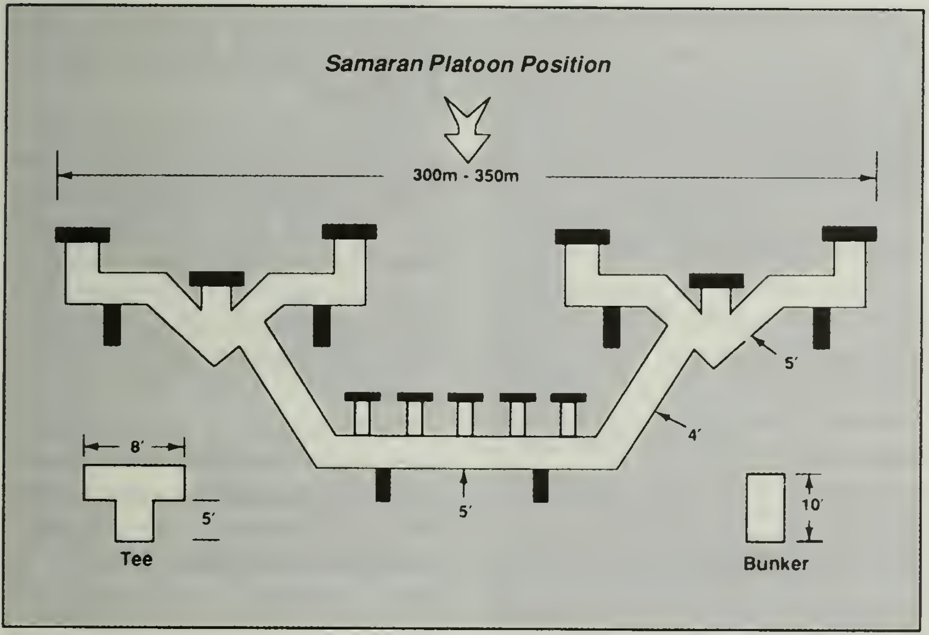


Figure 2

Iraqi Obstacles

The Iraqi obstacles in Kuwait consisted largely of concertina wire fences, anti-tank ditches, minefields, berms, barbed wire, flame ditches, and trenches. Figure 1 shows a typical obstacle layout. The minefield on the enemy side is normally a condensed minefield with buried anti-tank and anti-personnel mines. Most of these were pressure-fuzed and overpressure-protected. The wire obstacles were generally triple-strand concertina and four-strand barbed wire fences. The anti-tank ditch was slightly larger than American tank ditches, and did not have a berm on the friendly side, where the spoil is spread.

Not all Iraqi trench systems in Kuwait were constructed to a standard design. Though they were generally platoon-sized trenches, individual commanders apparently had the flexibility to modify the trenches to support METT-T (mission, enemy, terrain, troops and time available). There is also some evidence to suggest that standard designs were not followed because of engineer constraints in time or equipment. While most of these trenches were linear, some were shaped like a "lazy W" or a champagne glass.

Behind these trench systems were vehicle fighting and survivability positions. These usually consisted of horseshoe-shaped berms built up to at least the hull defilade level. These positions were generally well located to allow the vehicles to make full use of long-range tank-killing weapons systems.

Samaran Obstacles

In an attempt to replicate the Iraqi obstacles in Kuwait, without compromising current intelligence-gathering activities, the NTC developed a "Samaran" obstacle system, incorporating minefields, wire, tank ditches and platoon trenches.

The minefields in this design were notional buried minefields. Friendly forces would have to "go through the motions" to breach the minefield. The anti-tank ditch design was similar to our own doctrine, with a berm on the friendly side. Wire fences were triple-strand concertina, but without barbed wire strung on top of the concertina. The design of the trench system took on the "lazy W" design, with three squad trenches connected by two communication trenches. (Figure 2).

Each trench system had a "T" shaped fighting position, with berms and overhead cover across the front, and bunkers across the back. These systems were 300 to 350 meters long, and were constructed linearly along the back of the obstacle belt. These could also have been constructed in depth. This design provided a good

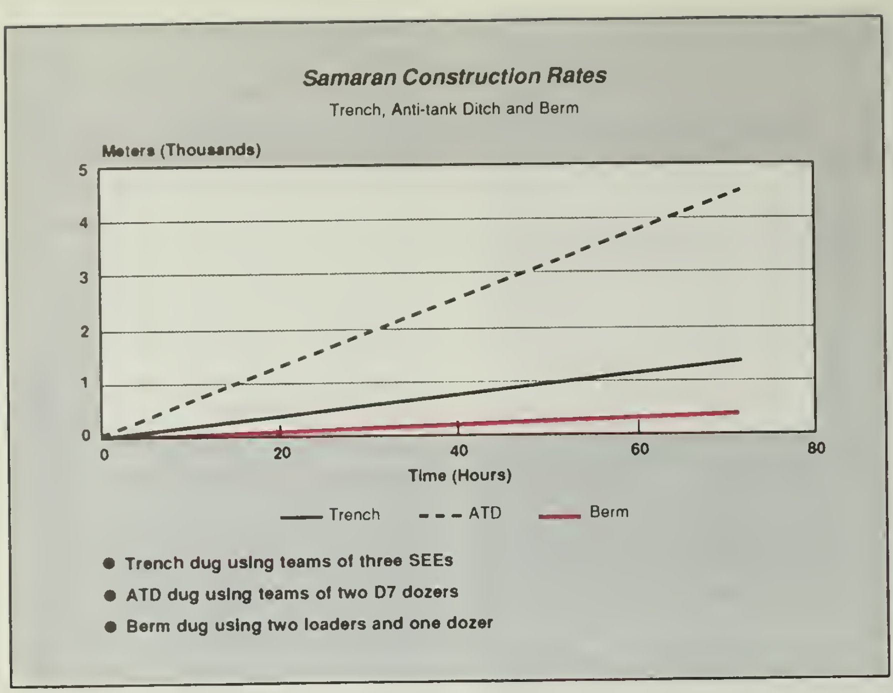


Figure 3

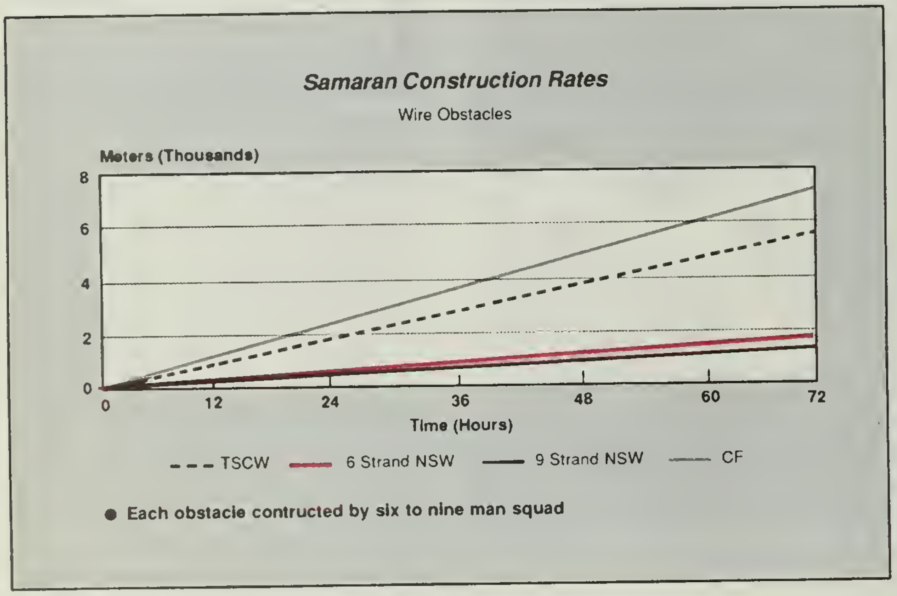


Figure 4

approximation of Iraqi obstacles, without compromising the extent of our knowledge of the obstacle systems in Kuwait.

Obstacle 14

Soon after arriving at the NTC, the battalion began construction of what was to become the largest obstacle ever constructed at Fort Irwin. Obstacle 14, as it came to be known, was 6.2 kilometers (km) long, and included 24 platoon trench systems.

Construction started on December 5, with the initial planned size to be 10 km, with 32 platoon trenches. However, to ensure completion by the time the first Saudi-bound unit arrived for training on January 3, the obstacle was downsized. The obstacle was oriented to the east, beginning in the vicinity of Langford Lake, and stretching to the south (map, page 18).

To facilitate construction, the battalion consolidated all of its SEE (small emplacement excavator) assets under one company commander. This proved to be a valuable arrangement, providing leadership continuity and consistent quality control. The battalion used three to seven SEEs on each trench system. Up to three SEEs would dig the squad and communication trenches first, then the remaining SEEs would begin work on the "Ts" and bunkers. Construction of the first trench system was completed in nine hours using seven SEEs. After some practice, operators using three SEEs were able to construct one complete platoon trench in 19 hours.

Dozers were also placed under the control of one company. Teams of two dozers began digging along the trace of the anti-tank ditch which had already been marked. Simultaneously, line platoons began construction on the wire obstacles forward of the trench systems.

Construction of the anti-tank ditch and wire obstacles were completed in a matter of days. The trenches, however, were not completed until December 17.

Construction Rates

After analyzing construction data, the battalion was able to determine real-world work rates, and compare them to American planning rates, and intelligence figures on Iraqi engineers. As suspected, the heavy equipment operators were not able to maintain the planned work rates.

Several factors contributed to the slower work rate, including maintenance downtime, refueling, crew rest, and—most significantly—the hard soil conditions at

Obstacle Construction Rates

U.S. Planning Rates	*NTC Experience*	*Iraqi Intelligence*
73m/hr (2 dozer team) 69m/hr (2 ACE team) (11′ wide x 6′ deep)	Ditching 62m/hr (2 dozer team) (11' wide x 6' deep)	74m/hr (2 dozer team) (4m Wide x 3m deep)
22m/hr (1 SEE) (2.5′ wide x 4.5′ deep)	Trenching 12m/hr (1 SEE) (2.5' wide x 4.5' deep)	672m/hr (1m wide x 2m deep)

Figure 5

Fort Irwin. Generally speaking, companies maintained a 16-hour work day, starting at 6 a.m., with about 12 hours being productive work time.

The larger pieces of equipment, like bulldozers and bucket loaders, were staged at the obstacle to minimize the loss of work due to travel time. Figures 3 and 4 show some of the work rates achieved by the battalion during the construction of Obstacle 14. Shown are non-stop rates for one piece of equipment or team.

Figure 5 compares the battalion's rates to what Iraqi engineers might have been able to achieve.

Equipment Experiences

Construction of the Samaran trenches pushed the battalion's equipment to the limits. The maintenance lessons learned center around the rugged NTC terrain, and the high operations tempo.

The SEE was the workhorse for the trench system, but it experienced some problems. Initially, operators had to tighten frame bolts after every hour of work. The battalion motor officer, after some field-expedient experimentation, came up with a replacement bolt system that solved the loosening problem.

Problems also surfaced with the SEE buckets. During the early stage of the operation, the buckets failed after about three hours of work and had to be repaired. Again, an expedient modification—welding an additional plate to the bottom of the bucket—saved downtime. Maintenance personnel went a step further, and replaced the original bucket with a stronger bucket purchased locally. Both modifications significantly reduced the amount of time lost to inoperable equipment.

Other precautions included inspection and as-needed replacement of SEE bucket teeth and dozer blade cutting edges, along with twice-daily, on-site lubrication. Mechanics also removed dozer belly pans once a week for inspection.

Operation Lessons

The battalion found that dozers with rippers were valuable digging assets during the construction of the anti-tank ditch. If only a limited number of dozers with rippers were available, then they would dig from within the ditch. Non-ripper dozers would push the spoil to the friendly side. Because of high wind conditions during the winter, we found that we had to push spoil further away from the back edge of the ditch to decrease the amount of fall-in. This lesson was learned the hard way, when the battalion returned from a Christmas break to find much of the tank ditch partially or completely filled in with blown sand.

When the SEEs were digging the trench systems, the most effective organization was found to be SEE teams—as mentioned earlier—with NCOs supervising the digging. During limited visibility, SEE operators found it difficult to judge the depth of the trench, and the supervisors proved valuable in directing the operators.

Battalion graders cut a combat trail along the front and back of the trench systems, so that the SEEs could easily move up and down the line of trenches. This speeded construction because the top-heavy SEEs were able to travel faster on these trails than on the bumpy desert floor. Too, the creosote bushes found at the NTC can cause tire punctures, and the combat trails enabled the SEEs to avoid these hazards.

The Samaran obstacles at the NTC were designed and constructed specifically for preparing Reserve Component units for combat against Iraq. Though they were a departure from the standard OPFOR regimen, the obstacles were of tremendous training value for maneuver units as well as the 14th battalion. And for the 14th Combat Engineer Battalion, that value came not only through construction operations, but through the first-hand experience of building an Iraqi/Soviet-style obstacle complex.

Captain Sawyer is assistant S-3 for the 14th Combat Engineer Battalion. Previous engineer assignments include company executive officer and platoon leader. Before transferring to Engineer Branch, he served as an infantry rifle platoon leader, mortar platoon leader, and S-1. He is a graduate of West Point and the Engineer Officers Advanced Course.

Engineer Problem

The following problem will acquaint you with the activity on the node (AON) method of preparing logic networks and solving resource-constrained problems.

Students learning project management in the Engineer School are presently introduced to two methods of solving logic networks. The first, activity on the arrow (AOA), is the method currently promoted as the Army standard. The second is AON. Both methods are described in FM 5-333, Construction Management (AOA is discussed in Chapter 2, and AON is in Appendix B).

Beginning in January 1992, the Engineer School's focus of instruction will shift from AOA to AON. This move will have advantages for both students and instructors. Activity on the node has a simplified logic network and a simplified resource constraining procedure. It is easier to learn and requires less time to teach. Also, AON is the technique taught in most engineer colleges and is the method most widely used in the private sector.

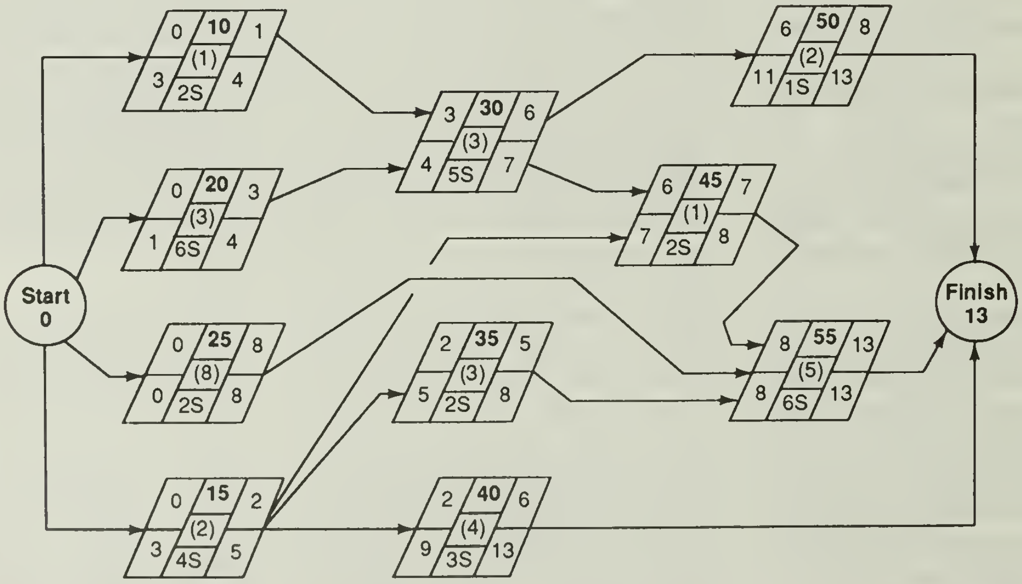
Problem: As a project supervisor, you developed the logic diagram and early start schedule shown below. During initial planning, the number of available squads (14) was the only critical resource. Later you were tasked to provide three squads to support post clean up during the same time period. This has reduced the number of squads available for the project to 11. You must resource constrain the project to 11 squads by completing the following tasks:

a. Resource constrain the early start schedule. (PART I of procedure)

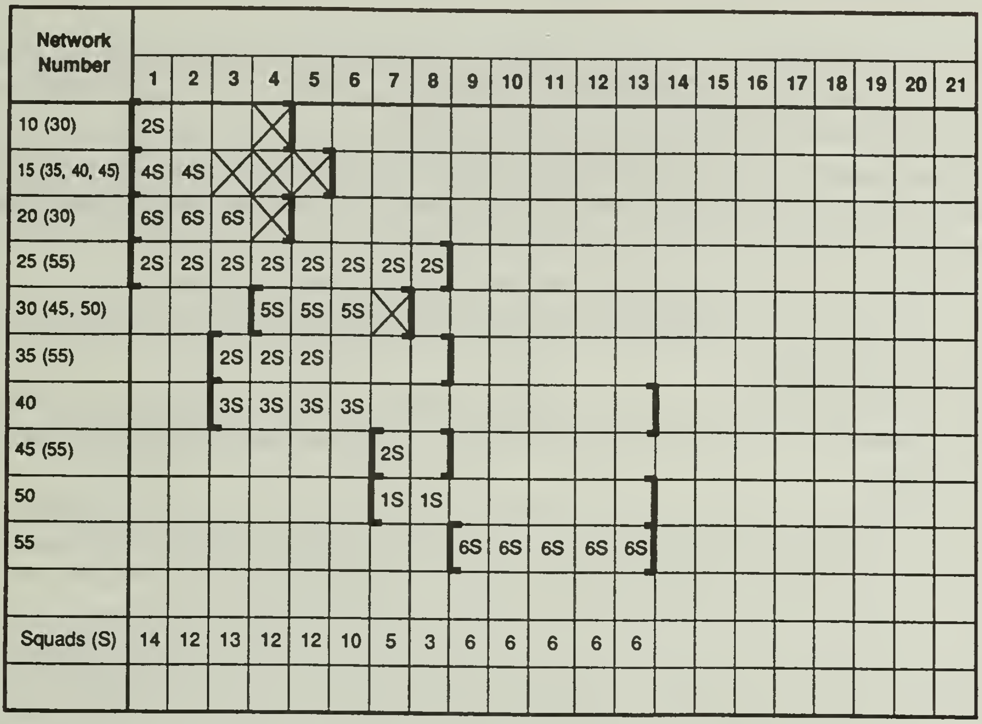
b. Update the logic network. (PART II of procedure)

c. Update the early start schedule. (PART III of procedure)

d. Determine if the reduced number of squads affects the project duration.



Engineer Problem



Network Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
10 (30)	2S			☒																	
15 (35, 40, 45)	4S	4S	☒	☒	☒																
20 (30)	6S	6S	6S	☒																	
25 (55)	2S	2S	2S	2S	2S	2S	2S	2S													
30 (45, 50)				5S	5S	5S	☒														
35 (55)			2S	2S	2S																
40			3S	3S	3S	3S															
45 (55)							2S														
50							1S	1S													
55									6S	6S	6S	6S	6S								
Squads (S)	14	12	13	12	12	10	5	3	6	6	6	6	6								

The following step-by-step procedure is one way to solve this problem. Although a procedure to constrain resources is not presently included in FM 5-333, this procedure will be used during future instruction at the Engineer School. Your comments and recommendations for changes are welcome and should be addressed to: U.S. Army Engineer School, ATTN: ATSE-DI-CC, Fort Leonard Wood, MO 65473.

Procedure To Constrain Resources (AON)

PART I: Resource Constrain The Early Start Schedule

Step 1. *Find the first time period where resource requirements exceed the resources allocated.*

Step 2. *Choose an activity(s) to delay.* Review the activities that begin in the time period identified in Step 1 and that provide sufficient resources. Choose the activity that has the largest amount of total float (the amount of time an activity can be delayed without delaying the project). Delay that activity one time unit.

- If one activity will not provide enough resources, choose a combination of activities that meets the resource requirement.
- If more than one activity qualifies as having the most total float, delay the one with the most free float (the amount of time an activity can be delayed without delaying any other activity).
- If there are no activities with float, choose one on the critical path to delay.

Step 3. *Follow the delay through the schedule.* If an activity is delayed into interfering float or past its right bracket (late finish), follow the delay through the schedule. (An activity delayed into interfering float will delay an activity but not delay project duration.)

Engineer Problem

- To accomplish Step 3, you must identify all activities that logically follow the delayed activity. These activity numbers are shown in parenthesis behind the delayed activity. For example: Activity 25(30,40) indicates that activities 30 and 40 logically follow activity 25.
- Check each activity shown in parenthesis (Step 3a) to see if its early start (ES) comes before the early finish (EF) of the activity delayed for insufficient resource. If so, delay that activity's start until the first time period after the early finish of the activity delayed for insufficient resource.
- Repeat Steps 3a and 3b for all activities that are delayed into interfering float.

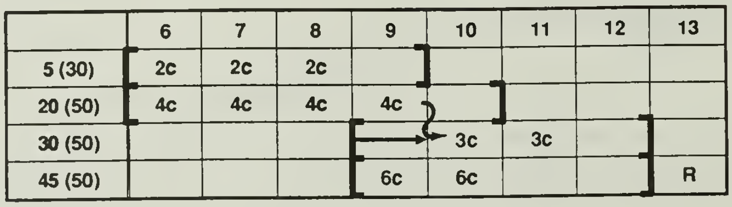
Step 4. *Sum resources.* After following the delay through the schedule, determine the total resource requirement for each time period.

Step 5. *Move to the next time period.* Go to the next time period where required resources exceed the resources available. Repeat Steps 2 through 4 until the entire schedule has been adjusted to meet the resource limitations.

Step 6. *Identify reason for the delays.* If insufficient resources caused an activity to be delayed, place an "R" at the right of its late finish (LF) bracket (see example). If logic caused an activity to be delayed (it follows an activity delayed because of resources or logic), place an "L" at the right of its late finish bracket.

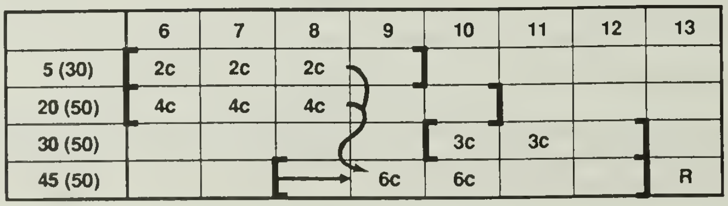
Step 7. *Draw the resource flow arrow(s).* Each resource-delayed activity is immediately preceded by an activity(s) that uses the same resource and has an early finish one time period before the resource-delayed activity begins. If two or more preceding activities use the same resource, you must choose one. Normally you will choose the one that provides the least, but sufficient, resources. Find the source of the resource and draw a resource flow arrow(s) from the end of the preceding activity(s) to the beginning of the resource-delayed activity.

In the following example, activity 30 is resource delayed and will begin on time period 10. Look at the preceding time period (9) for activities that end on it and that use the same resource. Activity 20 is the only one that ends on time period 9. Therefore, activity 20 must be completed before activity 30 can begin. In this example, you would draw the resource flow arrow from the end of activity 20 to the beginning of activity 30.



	6	7	8	9	10	11	12	13
5 (30)	2c	2c	2c					
20 (50)	4c	4c	4c	4c				
30 (50)					3c	3c		
45 (50)				6c	6c			R

Note: One activity may require assets from two or more activities, or one activity may provide assets for two or more activities. In the following example, activities 5 and 20 provide resources to activity 45.

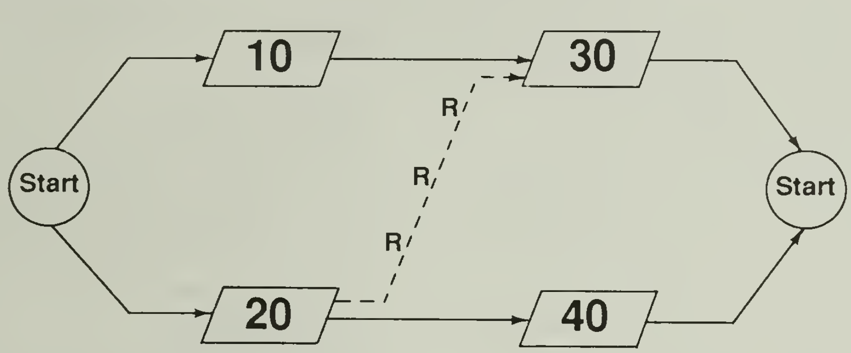


	6	7	8	9	10	11	12	13
5 (30)	2c	2c	2c					
20 (50)	4c	4c	4c					
30 (50)					3c	3c		
45 (50)				6c	6c			R

Engineer Problem

PART II: Update The Logic Network

Step 8. *Draw the resource dummy arrow.* A resource dummy arrow must be added to the logic network for every resource flow arrow on the early start schedule. Draw the resource dummy arrow from the activity(s) that provide the resource to the activity(s) that receive it. In the following example, activity 20 provides a resource to activity 30.



Step 9. *Conduct a new time analysis.* The addition of resource dummy arrows to the network changes the time analysis for the network and may change the critical path.

PART III: Update The Early Start Schedule

Step 10. *List activities.* Activities that provided resources will gain new follow-on activity numbers (numbers in parenthesis). Adjust the activity numbers on the early start schedule.

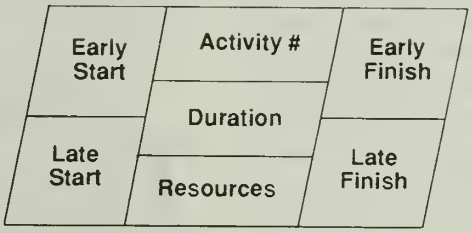
Step 11: *Mark time frames.* Check the early start (ES) and late finish (LF) times for all activities. If an activity's ES or LF changed, adjust the left and right brackets accordingly.

Step 12: *Identify float.* Recalculate interfering float for each activity based on the new ES and LF times. Update the interfering float "XX" on the early start schedule.

The node shown below is from Appendix B of FM 5-333.

Activity on the Node Time Analysis

Early Start (ES) + Duration = Early Finish (EF)



Late Finish (LF) - Duration = Late Start (LS)

Reference: FM 5-333, Chapter 2 and Appendix B.

ENGINEER Solution begins on page 49.

Engineers As Part of the Combined Arms Reconnaissance Team

By Captain Bob Wray

The success of an offensive or defensive operation often depends directly on the success of the reconnaissance effort. This effort enables the maneuver commander to see the battlefield. Likewise, the ability of engineers to support maneuver units depends on the success of the engineer reconnaissance effort. This article describes two types of reconnaissance, and provides an overview of the combined arms planning process.

There are two basic types of engineer reconnaissance: technical and tactical. The reconnaissance missions are conducted under different threat environments, focus on different engineer-specific information requirements, and are executed and organized differently (Figure 1).

Technical Reconnaissance

Technical reconnaissance missions focus on collecting engineer information about a target, area or route. This type of reconnaissance gathers engineer information about the target without regard to the enemy. It is usually conducted under a low level of threat and in areas physically controlled by friendly forces. The mission is normally a specified task from higher headquarters or is derived from mission analysis, and can be conducted by a pure engineer unit. A technical reconnaissance is typically conducted rear of the forward line of troops (FLOT). A combat engineer company could anticipate the following technical reconnaissance missions:

- River (unopposed river crossing)
- Engineer resource
- Bridge
- Route and road
- Landing area
- Tunnel
- Ford and ferry (unopposed)
- Water resource

General Types of Engineer Recon Missions

Technical Recon:

- Collect engineer specific technical data on a point, area target, or route
- Normally a specified task from higher headquarters
- Conducted in a Level 1 threat environment
- May involve only engineer forces

Tactical Recon:

- Collect engineer specific information requirements on an enemy point, area target, or attack axis/route
- Implied task to support maneuver plan
- Conducted in Level 3 threat environment
- Combined arms effort: Engineer force is just part of total intelligence collection effort

Figure 1

The basic references for technical reconnaissance are Field Manual (FM) 5-36, *Route Reconnaissance and Classification*, FM 5-34, *Engineer Field Data*, FM 90-13, *River Crossing Operations, Technical Manual* (TM) 5-312, *Military Fixed Bridges,* TM 5-330, *Planning and Design of Roads, Airbases, and Heliports in the Theater of Operations*, and TM 5-700, *Field Water Supply.*

Tactical Reconnaissance

Tactical reconnaissance is conducted against a target in areas where enemy contact is likely, and the reconnaissance mission is an integral part of confirming or denying the intelligence preparation of the battlefield (IPB) and developing a scheme of maneuver. These missions normally are not specified, but fall out as an implied task. Engineer forces participate in tactical reconnaissance as part of a combined arms team consisting of scouts, infantry or cavalry patrols. Tactical reconnaissance is typically performed forward of a task force rear boundary. The combat engineer company could anticipate the following tactical reconnaissance missions:

- Enemy obstacle
- River
- Landing/pick-up zone (PZ/LZ)
- Terrain
- Choke points
- Friendly situational obstacle
- Friendly reserve obstacle (bridge demolitions, road craters, etc..)
- MOUT (building evaluations, utility facility recons)

The basic references for tactical reconnaissance are FM 5-34, *Engineer Field Data*, FM 20-32, *Mine/Countermine Operations*, FM 90-13-1, *Combined Arms Breaching Operations*, FM 5-25, *Explosives and Demolitions*, FM 7-7, *The Mechanized Infantry Platoon and Squad*, and FM 7-70, *Light Infantry Platoon/Squad*.

These two categories of engineer reconnaissance are critical to developing and training engineer squads. They provide the baseline for the tactics, techniques and procedures for each reconnaissance mission, and will help focus training and squad reconnaissance drills. The new FM 5-36, *Engineer Reconnaissance*, will reflect the two categories. The remainder of this article concentrates on tactical reconnaissance.

Engineer Tactical Recon Planning and the Estimate Process

Engineer Estimate	*Recon Planning*
Mission	Specified region tasks
Engineer battlefield assessment	Identify possible NAIs Identify recon assets available in adjacent recon efforts
Participate in IPB	Establish IRs and integrate into collection plan
Commander's guidance	Establish PIR
Mission analysis	Identify specified/implied recon missions
Develop scheme of engineer operations	Allocate recon assets to accomplish recon missions and develop tentative recon plan
Wargame and compare	Deconflict recon plan with other staff/manuever plans
Finalize plan	Integrate recon plan into order, and complete coordination

Note: Recon assets may have to deploy before estimate process is complete based on tentative NAIs and PIRs.

Figure 2

Recon Planning

Combined arms engineer reconnaissance planning is conducted as an integral part of the engineer estimate. Figure 2 shows the reconnaissance planning steps and how they integrate with the engineer estimate process. The estimate process provides the foundation for developing a reconnaissance plan. However, an engineer reconnaissance mission may require engineer forces to deploy with scouts prior to completion of the estimate process. When engineer reconnaissance forces deploy early, the task force engineer must consider how he will shift the reconnaissance effort as the planning process matures.

Mission. Knowledge of the mission should automatically start to focus intelligence requirements. Deliberate attack, hasty attack, hasty defense, or movement to contact missions generally call for general intelligence targets. For example, in the offense, obstacle intelligence, mobile obstacle detachment location, terrain data, enemy survivability effort, enemy countermobility and mobility asset location, and engineer low density equipment location are intelligence requirements which can help confirm or deny the situational template.

In the subunit instructions, an engineer company could receive a specified reconnaissance mission. Characteristically, the engineer subunit mission will be a technical reconnaissance. The task force engineer needs to be aware of the maneuver unit's specified reconnaissance task, and higher headquarter's priority intelligence requirements. This article uses the deliberate attack as an example.

Engineer Battlefield Assessment. The engineer battlefield assessment [EBA] is the basis of the engineer's input into the IPB and, therefore, becomes the foundation for reconnaissance planning. During terrain analyses, the engineer and S-2 identify key and decisive terrain features whose engineer characteristics are important to the maneuver plan. The S-2 uses the higher headquarter's situational template and refines it (Figure 3). The task force engineer uses the S-2's template of the enemy location, along with other

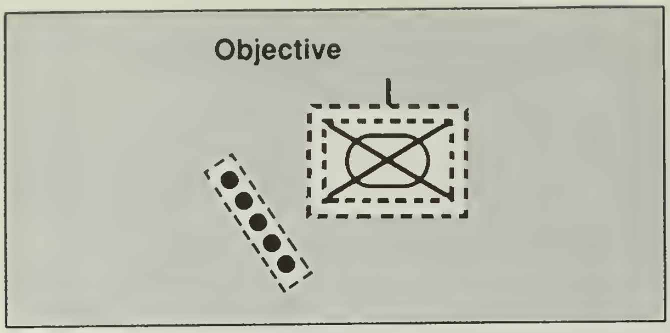


Figure 3

Recon Planning and Engineer Battlefield Assessment

Terrain and weather analyses:
- Identify key terrain features requiring engineer recon (technical or tactical)
- Focus on existing obstacles that impact on maneuver forces

Enemy M/CM/S capability and employment
- Template enemy engineer activities
- Identify possible NAI's/information requirements
- Begin to establish priorities

Friendly M/CM/S capability
- Identify friendly recon assets available
- Include engineer, maneuver, and intelligence assets
- Coordinate with adjacent engineer recon efforts
- Identify necessary recon equipment

Figure 4

Recon Planning Input to the IPB

Provide input into S-2's terrain analysis
- Determine impact existing obstacles have on avenues of approach and mobility corridors
- *Prioritize* engineer recon to confirm terrain analysis and begin recon early

Provide input into the S-2's doctrinal and situation template
- Base your input on enemy M/CM/S assessment
- Identify tentative NAI's and information requirements

Provide input into the S-2's collection plan
- S-2 and engineer develop coordinated list of NAI's and information requirements
- Ensure mutual support is planned

Figure 5

facts and assumptions, in order to template enemy mobility/countermobility/survivability capabilities (Figure 4). This procedure assists the engineer and S-2 in focusing tactical reconnaissance on specific named areas of interest (NAIs) to collect the information requirements/priority information requirements (IRs/PIRs) (Figure 5). Figure 6 shows a refined situation template with NAIs annotated. Mission-critical NAIs and PIRs can now be prioritized.

The S-2 and engineer also look at adjacent reconnaissance efforts which impact on the area of operations. Last, the engineer considers the friendly engineer capability and reviews the combined arms assets available for collecting engineer intelligence. Those usually include:

- **Scouts** - Used to recon areas in close proximity to the enemy. Scouts reconnoiter to determine enemy locations, orientations, and dispositions. Before, during, and after the battle, they report their observations and significant changes in enemy activity.
- **Ground Surveillance Radars (GSRs)** - A GSR can detect moving vehicles and personnel in open terrain at long ranges, and it can provide information on the number, location, disposition, and types of targets. Normally, GSRs are placed to cover open, high-speed approaches where early detection is critical.
- **Remote Sensor Teams (REMS)** - Like GSRs, REMS are division assets attached or placed in direct support. The REMS should be placed as far forward as possible. They are useful in covering dead space and broken terrain where observation would require more observation posts (OPs) or patrols than are available. They can also assist in detecting attempts to breach friendly obstacles and in keeping track of enemy movements after security force withdrawal.
- **Maneuver Listening/Observation Posts (LP/OPs)** - LP/OPs are used to observe or listen to the front, or in gaps between friendly positions. They provide early warning of the enemy's advance.
- **Patrols** - Patrols are conducted to cover unoccupied gaps between defensive positions. On occasion, patrols also may cover the terrain between OPs to the front. This is normally accomplished by the occupying unit during a defensive operation.
- **Engineers** - Engineers are used specifically to gain intelligence on the enemy's mobility/countermobility/ survivability operations and friendly OCOKA requirements.

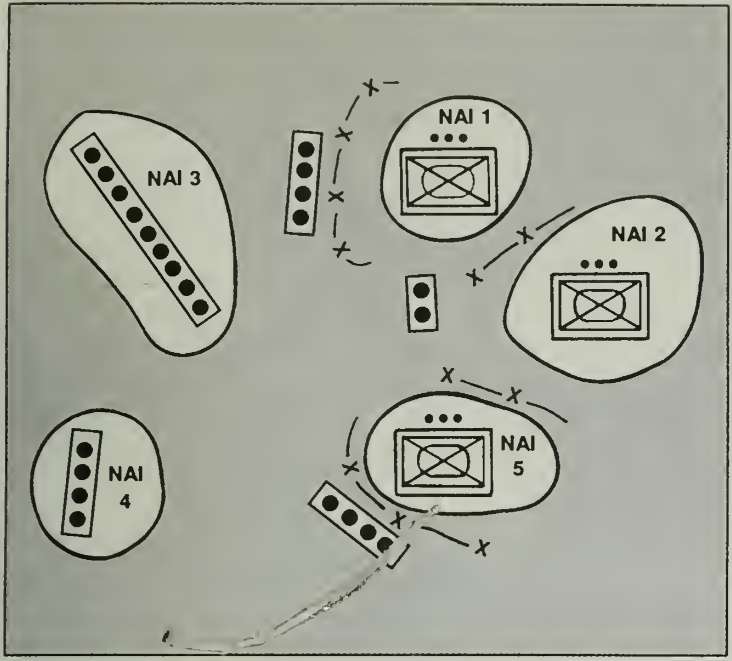


Figure 6

Recon Planning and Mission Analysis/Commander's Guidance

Identify all specified recon missions
- Based on higher's basic OPORDER
- Intelligence annex
- Engineer annex
- Higher engineer OPORDER

Identify implied engineer recon missions
- Based on EBA and IPB input
- Prioritize recon missions
- Identify recon missions that are essential tasks

Recon missions and priorities may change as maneuver plans are developed

Establish PIR based on commander's guidance

Figure 7

- **Aerial Reconnaissance** - You must coordinate for these assets—if they are available at the battalion task force level. Imagery and photography products can compliment your intelligence collection plan. Ensure the requests for these products are submitted. On numerous occasions, the products are not "pushed" through the system. Aviation assets can be task organized to the battalion task force for specific missions. OH-58s can be requested to cover specific areas, routes or targets (Refer to FM 17-95 *Cavalry Operations*). Be sure to consider SEAD (suppression of enemy air defenses) and air superiority when planning and requesting these assets.

Commander's Guidance. The commander's guidance is given after the restated mission of the command estimate. The restated mission confirms the essential tasks expressed in the mission statement. This aids in determining and recommending PIRs to the commander. He confirms the PIRs, and the staff engineer ensures that intelligence requirements are included in his recommendation.

Mission Analysis. Recon tasks identified in the IPB process and R&S (reconnaissance and surveillance) planning are included in the mission analysis. The engineer considers all engineer recon missions given by higher headquarters as specified tasks. These tasks are usually technical recon missions. The engineer also identifies implied technical and tactical recon missions as implied missions. Mission-critical technical and tactical engineer recon missions are identified as essential tasks and become the main effort in recon planning and force allocation.

A word of caution: engineer recon mission priorities may change as maneuver plans are developed and refined, or they may change as the situation changes (Figure 7). Time analysis of the command estimate might drive specific NAIs to be more important than others. Mission analysis provides the framework for a reconnaissance and surveillance plan with NAIs, targeted areas of interests (TAIs) and PIRs.

Develop Scheme of Engineer Operations. The scheme of engineer operations is developed concurrently with the maneuver course of action. Figure 8 shows a generic offensive scheme of maneuver. Engineer recon efforts are included in the development of a scheme of engineer operations. The engineer analyzes the recon tasks that have been identified and looks at where they occur on the battlefield. He knows the assets available from his EBA analysis, and so allocates the engineer forces necessary to accomplish the recon task. Normally, an engineer squad is capable of reconnoitering one target at a time. Large targets may require an entire platoon.

In some cases, using non-engineer intelligence collection assets is more appropriate. Scouts, patrols, GSRs and aviation recon efforts may be tasked to collect engineer IRs in coordination with the S-2. The engineer will then task organize engineer assets allocated to the recon effort based on the type reconnaissance and the type of force commanding and controlling the recon effort. As a rule of thumb, engineer forces conducting technical recons remain task organized under engineer

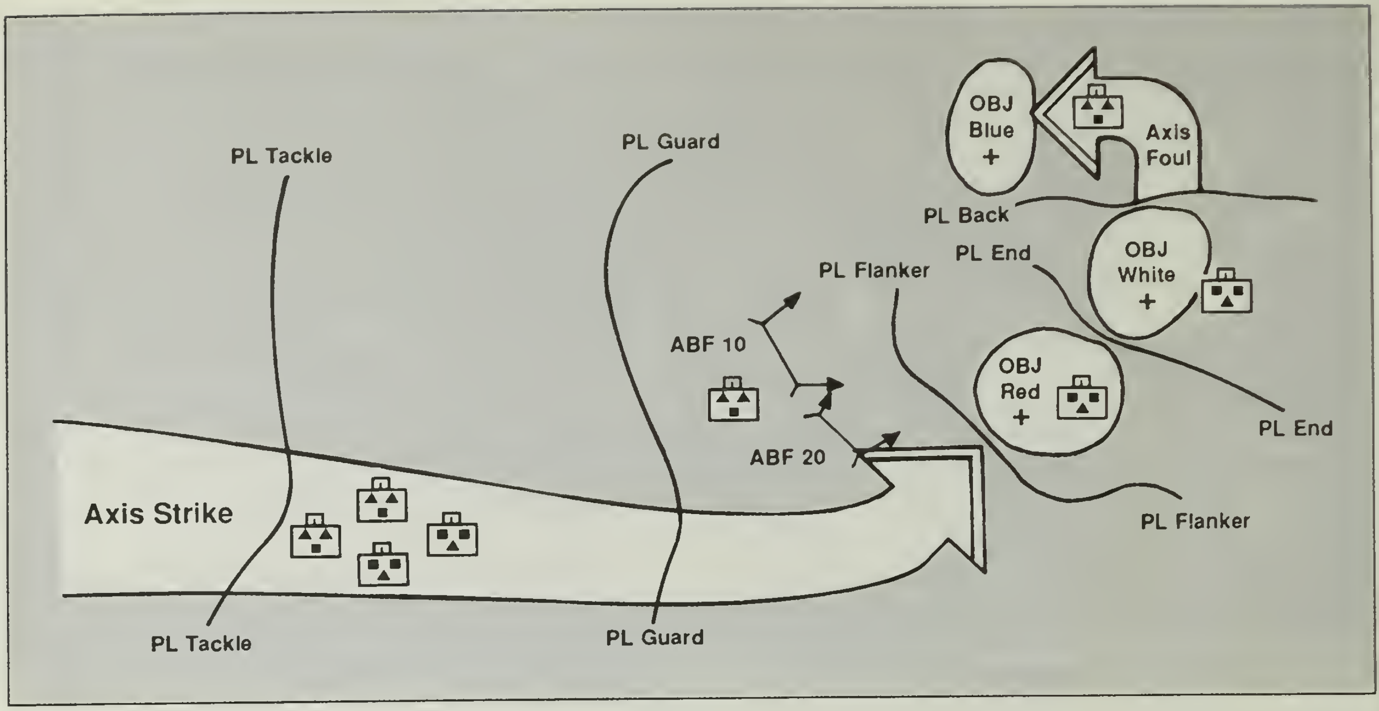


Figure 8

headquarters. Engineer forces conducting tactical recons are task organized as attached to a maneuver headquarters—usually the task force or battalion scouts. The engineer integrates engineer recon forces, missions, and priorities into the total scheme of engineer operations.

Engineers are trained to conduct obstacle and fortification reconnaissance to evaluate the technical nature of these works. Scouts and infantry also conduct obstacle reconnaissance, and are experts in tactical maneuver and reconnaissance. Maneuver unit recon assets are normally better than an engineer squad at collecting information in NAIs that are close to the enemy location. However, increasing engineer recon training can compensate for this. For example, in support of an offense operation, engineers would focus on the NAIs covering the enemy's tactical obstacles, while the scouts would focus on the NAIs covering the enemy's weapon systems and protective obstacles.

Finalize The Engineer Recon Plan

Assign specific NAIs, IR/PIR to subordinate units

Integrate engineer recon effort into BDE/TF OPORDER (R&S plan)

Coordinate recon routes with other staff members and unit commanders

Brief engineer recon effort at the OPORDER

Develop engineer recon tracking/command and control systems

Specify how hard intelligence will be disseminated

- By whom
- To whom
- Where
- When
- Using what means (radio, FAX, courier)

Figure 9

Wargame and Refine. The engineer always participates in the wargaming process. Wargaming offers the engineer an excellent opportunity to look at his recon effort in the context of the maneuver plan and other recon efforts. It helps him identify weaknesses in his recon plan. As the maneuver plan is wargamed, the engineer should consider how well his recon plan has provided the information needed to successfully execute the maneuver plan. As a result, the engineer may identify the need for additional NAIs and IRs. He also looks for conflicts such as recon assets that are operating in an area of indirect preparatory fires.

Finalize Plan. In coordination with the TF S-3, S-2, and commander, the engineer finalizes his recon plan. Engineer forces participating in the recon effort are given specific NAIs and IRs as sub unit instructions in the engineer company OPORD (Figure 9). If the reconnaissance assets have already moved out, their plan must be updated and the commander's intent given to the recon elements. This critical point is often overlooked. If the reconnaissance units know the commander's intent,

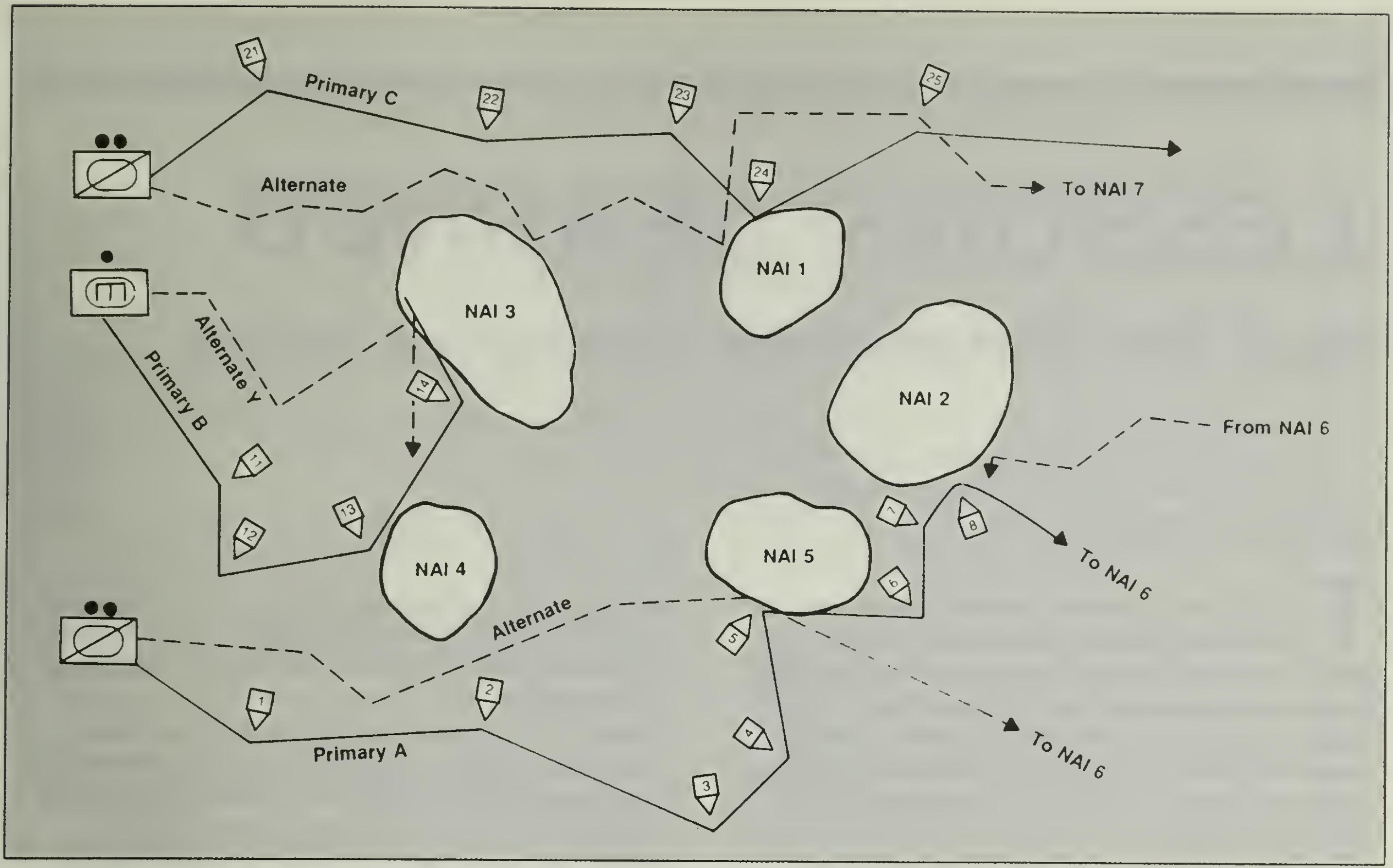


Figure 10

they will be better prepared to demonstrate the appropriate initiative to help the commander.

The staff engineer makes every effort to coordinate with other TF staff members and maneuver commanders. He ensures that engineer reconnaissance assets are given the appropriate NAIs, command and control, and logistics. It's important that the engineer brief his recon plan (as part of the TF plan) at the TF operations order (OPORD) to ensure that the plan is disseminated. As the engineer recon plan is finalized, the engineer must consider how he will track the progress of the recon effort, receive reports, and, if necessary, shift the recon focus. He must not only focus on his engineers, but on the total combined arms reconnaissance effort as well. The scout platoon leader integrates the engineers into his movement and develops his own movement plan (Figure 10).

Summary

This article has been limited to the engineer's planning process and his responsibilities as part of a combined arms staff. Combined arms reconnaissance planning should not be viewed as a check to block activity—the R&S plan confirms or denies the situation template. After the intelligence reports are received, the template is updated and refined and the S-2 and engineer develop new NAIs. As for all staff engineer planning, the engineer estimate provides the basic framework for engineer reconnaissance operations. After staff planning, engineer reconnaissance leaders must conduct standard troop leading procedures.

Engineers are a critical part of the combined arms reconnaissance effort, and must be proficient in recon operations and planning. Engineer leaders should take note, and make sure their units are trained up to the mission.

Captain Wray is an instructor/writer in the Engineer School's Tactics, Training and Doctrine Division. He previously served as a company commander and assistant S-3 with the 7th Engineer Battalion. He is a graduate of Command and General Staff College and the University of Louisville.

LESSONS LEARNED

Basic Rifle Marksmanship Sustainment Training

By Robert C. Clark

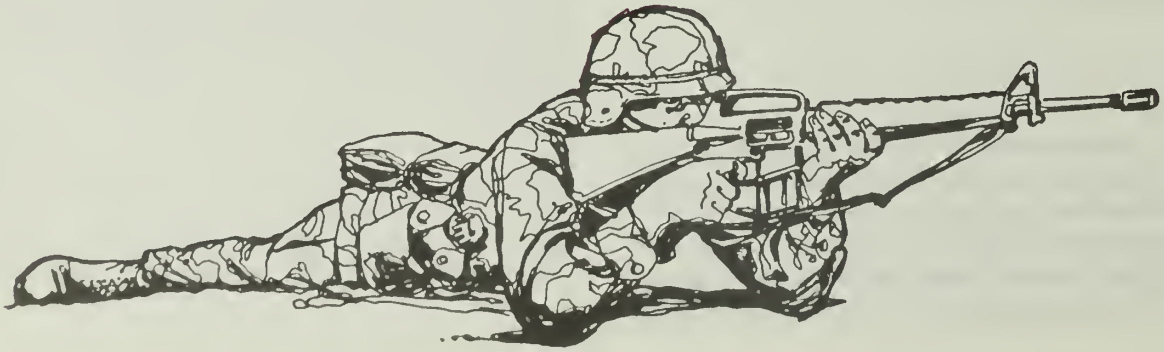
The following Lessons Learned apply to the unit Basic Rifle Marksmanship (BRM) training program. They are based on an evaluation of the BRM program conducted by the Engineer School's Directorate of Evaluation and Standardization (DOES). For more information, write to Commandant, U.S. Army Engineer School, ATSE-ESE, Fort Leonard Wood, MO, 65473-6630. Or, call (314) 563-5320, Autovon 676-5320.

ISSUE: Many soldiers who attend the Noncommissioned Officer's Basic and Advanced Courses (BNCOC and ANCOC) or the Engineer Officer's Basic Course (EOBC) are not prepared to learn the train-the-trainer skills taught in these professional development courses. Instead, they require training in the basic skills needed to qualify with a weapon. Students comment that their unit training programs are not designed to sustain BRM skills, as required in FM 23-9, *M16A1 Rifle* and M16A2 *Rifle Marksmanship*.

DISCUSSION: Analysis of the BRM program taught in NCO and officer courses at the Engineer Center revealed that the basic officer and NCO courses (EOBC and BNCOC) provided no training in BRM skills, and the advanced course (ANCOC) provided only familiarization training. To correct these deficiencies, rifle qualification became a requirement to graduate from EOBC, BNCOC, and ANCOC as of October 1990.

Many of the issues identified in this study relate directly to unit BRM sustainment skills. Student feedback through surveys and group discussions indicate that some soldiers were never assigned MI6AI or M16A2 rifles. And many unit BRM programs did not include a unit sustainment program, as required FM 23-9. Other key points—

- Basic rifle marksmanship training for BNCOC, ANCOC and EOBC provides instruction to leaders on how to plan, conduct, and evaluate rifle marksmanship sustainment training. It is not designed to train soldiers in basic BRM skills.
- While the intent of the BRM program in professional development courses is to train-the-trainer, soldiers report to them with skill deficiencies. They must be trained in the basic skills required to qualify with an individual weapon before they can learn the advanced tasks. Thus, instruction cannot focus on train-the-trainer skills. Instead, it focuses on ensuring soldiers qualify with the weapon so they can meet graduation requirements.



> ***"A unit can best sustain marksmanship proficiency by implementing a quality unit training program."***

During the DOES' evaluation, soldiers pointed out that:

- Many soldiers had not fired or qualified with their individual weapon since leaving Advanced Individual Training (AIT).
- Soldiers had not been exposed to pop-up targets (target detection) since AIT.
- Long periods often elapse between initial and sustainment training.
- Unit sustainment training often is not in accordance with FM 23-9. In many units emphasis is on qualification, not on sustaining individual soldier skills.

What Needs To Happen

To ensure soldier proficiency in BRM skills, commanders and trainers must first understand the Army's training goal and the standards and strategies for marksmanship training.

Training Goal: The Army's goal for training is to develop a combat-ready force that is prepared to mobilize and deploy on short notice and to fight and defeat enemies. DA Pam 350-38, *Standards in Weapons Training*, can help units attain this goal. It provides commanders and unit trainers with:

- A common set of weapon and weapon qualification standards
- Suggested weapon training strategies that will lead to the attainment and sustainment of measurable standards, and a model for resource requirements

Standards and Strategies: Commanders must design training strategies that will allow their soldiers to attain the BRM standards. DA Pam 350-38 provides models for training and the resources needed to attain the standards. The models provide generic, not specific, requirements and are one way to attain and sustain the standard.

Unit commanders can select from the generic menu of weapon training programs described in DA Pam 350-38 to train for a specific assigned mission or unit goal. This flexibility allows trainers to design programs that meet their needs.

For Example

As an engineer company commander in an engineer battalion, you are tasked to determine the requirements for qualifying your company on the M16A2 rifle. Using DA PAM 350-38, you determine that the soldiers are Category II (not members of a rifle or scout squad). Thus, 90 percent of the soldiers assigned an M16 rifle or M203 Grenade Launcher must have met the individual requirements for the M16 rifle to standard within the past 6 months. Individual requirements for Category II soldiers include qualifying on a day record fire course, firing in mission oriented protection posture (MOPP) 4 protective clothing to standard, and firing a night record course to standard.

Table 5-31 (DA PAM 350-38) recommends training strategies (firing events) that will enable soldiers to maintain and sustain proficiency with the M16 rifle. The table also lists ammunition allocation requirements for each weapon per firing event, which makes it easy for trainers to order the correct type and amount of ammunition.

Now you know the firing events, standards, and ammunition requirements for your unit. The next steps are to review the suggested training strategies in FM 23-9, plan the training, program the events into long-range training calendars, and then conduct the training to standard. You should use both DA Pam 350-38 and FM 23-9 to be sure the training and BRM qualification are conducted to standard.

Year-round Marksmanship Training

A year-round marksmanship training program will help units meet the Army's training goal.

An effective unit marksmanship program reflects the commander's and trainer's priority of interest and emphasis. Appendix A of FM 23-9 proposes a strategy to guide units in establishing and conducting an effective program. It includes a list of tools for individual and leader refresher training that can help soldiers maintain the basic skills learned during initial entry training (IET).

Unit sustainment training is a critical part of year-round marksmanship training. Studies show that soldier skills and marksmanship fundamentals deteriorate within two months, and mechanical skills weaken even sooner. Therefore, units should provide short periods of training throughout the year to maintain these skills.

A year-round marksmanship sustainment program enables units to attain and maintain their individual and collective firing proficiency skills. Many non-firing tasks can be accomplished as opportunities develop or concurrent with other training. Dry-fire training can strengthen marksmanship skills and assess training needs. The key is to make marksmanship training an on-going event.

Back To The Study

The DOES survey of students in BNCOC and ANCOC produced the following information:

- Of students surveyed, 66 percent indicated that BRM training in their units did not include target detection. This is a key element of BRM training and is a major reason why soldiers fail to qualify in their professional development courses. Appendix B of FM 23-9 provides tips to improve training in this area.
- Many units do not use training devices such as the M15A1 aiming card, riddle sight device, M16 sighting device, or the weaponeer. Several marksmanship training devices can enhance sustainment training when they are used with appropriate training strategies (see Appendix C, FM 23-9). These devices are especially useful when ammunition is limited. While some are complex, costly, and in limited supply, others are relatively simple, inexpensive, and in large supply. Devices can be used individually or in combinations.

  Individuals or squads should use these devices to practice and sustain basic marksmanship skills and fundamentals. The old philosophy that training can't be conducted because bullets and a range are lacking is no longer valid.

RECOMMENDATION: The Engineer Center recommends that commanders at every level ensure their unit sustainment training program conforms with FM 23-9, and that soldiers meet BRM standards at least semi-annually.

Soldiers are taught how to detect and hit a target, and how to maintain their weapons during IET. They must maintain these skills throughout their Army careers. Commanders at all levels are responsible for developing programs that enable soldiers to sustain these skills.

A year-round program is the best way to maintain the basic skills learned in IET. In these days of force reductions, only top quality soldiers are selected to attend professional development courses. If a student is not prepared to learn the train-the-trainer tasks there, his military career may be in jeopardy.

The following suggestions may help you develop a sound BRM program:

1. Use the training strategy chart (Figure 1-1) on page 1-2 of FM 23-9 as a guide when developing a sustainment program.

2. Know the standard. Review Chapter 5 and Tables 5-30 and 5-31 in DA PAM 350-38.

3. Integrate sufficient time for marksmanship training in the unit's mission essential task list (METL).

4. Assess your soldiers' proficiency.

5. Train the trainers.

6. Conduct refresher training.

7. Use training devices.

8. Ensure standards are met.

As we begin a new fiscal year, let me challenge you to include BRM in your overall training program. Commanders, examine each strategy as it applies to your unit's modified table of organization and equipment (MTOE), METL, training level, time available, and unique training needs. Implement a year-round marksmanship training program that will allow soldiers to sustain BRM skills and contribute to your unit's overall proficiency.

Robert Clark is a training specialist in the Directorate of Evaluation and Standardization at the Engineer School. Mr. Clark retired from the Army as a master sergeant, and has a bachelors degree in management from Columbia College, Missouri.

The Evolution of River Crossing Doctrine, 1918 to 1944

By Captain Robert Toguchi

Italy's Rapido River was shrouded in heavy fog as darkness fell shortly before 6 p.m. January 20, 1944. The soldiers of the 141st Infantry Regiment, 36th (US) Infantry Division, anxiously awaited movement to the water's edge for an assault river crossing. The regiment's commander, Lieutenant Colonel Aaron A. Wyatt, Jr., moved among his men as they made final preparations for the crossing.[1]

The first group of troops took their assault boats from a nearby depot, and departed for the river at 7 p.m. Pathways thick with mud made it a difficult journey. Barely 30 minutes later, more than sixteen battalions of friendly artillery began firing on defending German positions of the 15th Panzer Grenadier Division. German batteries replied, raining down shells on the Americans trying to make their way to the riverbank. Within minutes, one company lost 30 men.

The situation got worse as engineer guides lost their way in the artillery fire, and the advancing Americans entered friendly minefields. By 8 p.m., 25 percent of the boats and footbridges needed for the assault were lost. Radio and landline communications broke down. Some of the troops that managed to reach the river found that their boats had been pierced by shrapnel and sank when placed in the water. Other boats were swept away by the swift current before they could be loaded, and some sank because the crews paddled improperly. Of four footbridges designated for the crossing, one was destroyed in a minefield enroute to the riverbank, one was defective, and the remaining two were destroyed by artillery fire. By salvaging bits and pieces from each bridge, engineers managed to construct a single footbridge by 4 a.m., nearly seven hours after the designated crossing time.[2] By 6:30 a.m. on the 21st, only half a battalion of a three-battalion force had managed to get across the river.

With the approach of dawn, LTC Wyatt tried to put together a daylight operation to sustain the small force across the river. He considered using of smoke to conceal continued crossing operations. But much to his chagrin, Wyatt discovered that no smoke-generating equipment was available. Six hundred smoke pots were available at a rear depot, but the 141st was not notified of their availability until it was too late.[3]

Without concealment, the small foothold on the far shore of the

River crossing failures in the early days of World War Two cannot be laid entirely at the feet of the soldiers on the line. Institutional flaws in doctrine were a significant factor (U.S. Army photo).

Rapido was doomed. Consequently, Wyatt ordered the evacuation of the soldiers who had already crossed. Subsequent assaults the following day by the 141st and an adjoining regiment also failed. The 36th Division suffered 1,681 casualties and was forced to cancel the river crossing operation.[4]

The Rapido operation was one of the earliest attempts by the Army to conduct a river crossing in World War II—and it was a fiasco. Combat engineers had a critical role in support of the crossing, and—as a whole—they performed poorly. Prior to the operation, the regimental engineer had developed a crossing plan without consulting the infantry regiments. Pre-paratory bridging drills were not conducted. Pre-liminary roadwork was not accomplished. Bridging equipment was not adequately inspected. Coordination measures had not been established with the infantry. And these were just a few of the problems that led to one of the worst military disasters in American military history.[5]

Military doctrine provides the foundation and framework for commanders to build successful operations. The absence of river crossing doctrine was a key factor in the poor performance of the 141st Regiment and the 36th Division. In an attempt to analyze the state of U.S. Army Corps of Engineers' doctrine at the start of World War II, this article will focus on the evolution of river crossing doctrine during the prewar period and during the war itself, during the years 1918 to 1944.

Traditional histories of the Rapido river crossing have placed the overwhelming burden of responsibility squarely on the shoulders of senior commanders. I believe the factors influencing the operations's failure are far more complex than merely pointing the finger of culpability at local battle captains. To a certain degree, operational historians have a penchant for emphasizing the obvious while ignoring that Army systems can affect individual battles. This has resulted in traditional studies that have not always revealed the institutional flaws that doom certain battles before the first shot is fired. I contend that the Rapido river crossing operation was just such a battle, and that fundamental flaws existed in the Army's ability to produce viable crossing doctrine before World War II.

Doctrine, in military usage, is a word of fairly recent origin.[6] During the 14th century, the word "doctrine" was used to describe fundamental truths concerning a special field of knowledge. The term "military doctrine" does not appear to have entered American military jargon until the early 20th century. *The Dictionary of United States Army Terms* defines it as the: "compilation of principles and policies, applicable to a subject, which have been developed through experience or by theory, that represent the best available thought, and indicate and guide but do not bind in practice..."[7]

Official doctrine for the Corps of Engineers was provided primarily in the form of published field manuals or field service regulations that instructed soldiers and leaders on how to fight on the battlefield.[8] Subjects were diverse, ranging from basic survival techniques, to unit logistics, to combined arms operations. The field manual was the normal authority on the specific techniques or tactics to be used in a given battlefield situation.[9] So, to understand doctrine development during this period, we must look at the progressive changes made in those manuals.

The Corps first addressed the subject of river crossing doctrine in the 1862 *Manual for Engineer Troops,* a compilation of doctrinal instructions adopted from British, Austrian, and French manuals.[10] Since the Army had not developed such related doctrinal instructions prior to this time, the Corps translated and adopted the procedures then in use by foreign armies. This practice of copying the doctrinal instructions of the major European powers was quite common for developing military establishments of the period.

Despite the advent of highly mechanized maneuver forces, river crossing doctrine did not keep pace—often limiting the usefulness of those forces (U.S. Army photo).

Only one of the five chapters within the manual was devoted to river crossings. This chapter provided 27 pages of instruction that focused primarily on the technical aspects of pontoon bridge construction. It discussed construction materials, river conditions, bank preparations, fording, ferrying operations, and basic pontoon drills. While the manual provided valuable advice on methods of streamlining speed of construction, it did not provide instruction on tactics or coordination with the infantry.[11]

A revised version, *The Engineer Field Manual,* was published in 1904. This manual provided river crossing doctrine under a section devoted to floating bridges.[12] Again, instruction focused largely on the technical aspects of construction, and dealt only briefly with military tactics. The manual provided technical details on American bridging equipment, incorporating changes in bridge design since the 1862 manual.

This basic manual was popular, undergoing four revisions by 1917.[13] Interestingly, the floating bridge portion of the manual remained virtually the same. Basic pontoon bridge design did not experience significant change between the Civil War and World War I. As a result of the satisfactory results experienced during the Civil War, the Engineer Corps decided in 1869 to retain the Civil War pontoon bridge designs.[14]

In the years between the wars, engineer offices that played a key role in the development of river crossing doctrine included the Office of the Chief of Engineers, the Engineer Board, and the Engineer School. The Chief of Engineers was the primary authority for the formulation of engineer policy, and was responsible for the technical performance of all officers and enlisted men within the Corps.[15] The office was divided into two divisions, Civil Works and Military. The Military Division was responsible for personnel, intelligence, operations and training, construction, railways, and supply. The division also directed the activities of the two field agencies, the Engineer Board and Engineer School.[16]

The Engineer Board served as the Corps' proponent agency for research and development on all Army engineer equipment. The board also developed procedures that covered the technical aspects of construction, maintenance, handling, and storage of engineer equipment. The Engineer School, on the other hand, was responsible for the training of Army engineers, and for the development of engineer tactical doctrine. Both agencies submitted their concepts of doctrine and equipment to the Office of the Chief of Engineers for review.[17]

A contributing factor to the slow development of river crossing doctrine was the Engineer School's concentration on individual training for soldiers. Concerns other than engineer instruction received limited attention, and suffered considerably.

The school simply did not provide any formal provisions or institutional structure to ensure the consistent review and generation of river crossing doctrine. Similarly, the Office of the Chief of Engineers failed to ensure that the school updated and formulated the Army's river crossing doctrine.

Interestingly enough, many of the doctrinal concepts during the interwar period were developed by individual soldiers—independent of any support from the engineer hierarchy. Following World I, a number of after-action reports were written about the Army's European river crossing experiences. A young engineer, Captain William M. Hoge, completed a book in 1918 that provided frank after-action comments about the 5th Infantry Division's crossing of the Meuse River.

Despite the success of the operation, the soldiers of the 7th Engineer Regiment had to overcome several difficulties. The Meuse valley, about 600 meters in width, consisted of marshy flats that made ingress and egress difficult on both sides of the river. The hills overlooking the valley provided commanding fields of observation and fire for enemy artillery. The necessary use of French bridging equipment, which the Americans were not familiar with, compounded the regiment's problems.[18]

The engineers were able to overcome these obstacles through meticulous planning. Prior to the crossing, one engineer company received the dedicated mission for road preparation, infantry guides were designated, fascines were constructed to facilitate passage over mud, ramps were constructed over high banks, wagon loads were prioritized, and assault engineers were attached to the infantry brigades.[19] All of these measures were planned and executed prior to the crossing. While Hoge's book covered seemingly simple tactical procedures, it was the combination of all these techniques that paved the way for the success of the Meuse crossing.

From his review of the operation, it is evident that Captain Hoge captured valuable insights into the difficulties of organizing engineer assets for river crossing operations. He presented these ideas in a well-written book entitled *Engineers in the Crossing of the Meuse*. Unfortunately for the Army, none of this material was incorporated as approved doctrine into the engineer manual. The next revised version of the manual, which was published in 1932, did not include Captain Hoge's well-reasoned and coherent thoughts on river crossing.[20]

Other veterans of the war provided similar grass roots doctrinal material based on practical experience. In early 1920, Colonel R.R. Ralston, the Fourth Corps Engineer of the American Expeditionary Force, published an article in *The Military Engineer* that included discussions on World War I river crossings. The work titled "Engineers' Duties in the Field of War" was a compilation of senior officer comments on engineer doctrine.[21] While the article presented several perceptive insights from highly experienced senior officers, none were used for the formulation of crossing doctrine during that period.

In the article, Colonel John C. Lee, chief of staff for the 89th Division, stressed the importance of traffic control. He recommended prioritizing traffic, controlling local traffic with engineers, and having military police provide general traffic control.[22]

Colonel John Kingman, chief of staff for the 90th Division, recommended a three-phase approach for river crossings: (1) an infantry footbridge, (2) standard pontoon bridge, and (3) a timber trestle structure.[23] Kingman believed that a phased approach would preclude increasing the load capacity of the standard pontoon bridge.

During the period between the wars, traditional concepts of war slowed development of the Army's mechanized forces, further delaying the development of river crossing doctrine and equipment. The attitude among some Army planners was "the next war should be fought like the last one."[24] For example, the infantry branch was initially given responsibility for the organization and development of the tank corps. As perhaps an expected consequence, their concept of tank employment called for armor to play an infantry support role—rather than take its place as a large, mechanized maneuver force. This attitude, though not pervasive, limited the development of a mechanized force which would have forced planners to rethink river crossing operations.

Despite a reduced interest in warfighting concerns, the Corps updated the *Engineer Field Manual* in 1932, incorporating new material on modernized bridging equipment. The manual added technical details on the M1926 light bridge and the M1869 heavy bridge. The new instructions focused primarily on bridge construction techniques, bridge specifications, transportation, maintenance, and load capacities. Some tactical instruction was provided, with a recommendation that bridging operations be divided into four phases:

- pontoons to ferry infantry
- light pontoons to cross combat wagons
- heavy pontoons to cross heavy trains
- fixed bridging

While the manual was an improvement over earlier versions in many respects, tactical procedures filled no more than one page of instruction.[25]

While many valuable field reports were available from experienced combat engineers, doctrine writers often failed to use the information (U.S. Army photo).

As early as January 1941, the Office of the Chief of Engineers was aware of the extreme complexity of river crossing operations.[26] German crossing operations in May 1940 were reported in German publications and translated by Captain Paul W. Thompson, an American military observer stationed in Germany prior to our entry into World War II. Complete accounts of step-by-step crossing sequences, timetables, operational diagrams, fire support, equipment characteristics, bridge sites, and orders issued by the participating German units were available to the American engineers.[28] These materials were published in 1941 in several articles appearing in *The Military Engineer*. Later that year, Captain Thompson published a book, *Modern Battles*, that depicted modern German doctrine for assault river crossings.[29] In 1942, now-Lieutenant Colonel Thompson published two more books, the *Army Engineer* and *Engineers in Battle*, which provided material superior to doctrinal literature then available on river crossing.[30]

While detailed reports on successful river crossing operations were flowing out of Europe, where were the doctrinal writers in the Engineer Corps? Thompson's publications were a valuable and cost-free opportunity for the Corps to update existing crossing doctrine. Engineers in the field needed more definitive guidance than the general overview of crossing operations officially available at the time. But strangely enough, comparable changes to the existing river crossing doctrine did not occur until 1943.

In 1941, the river crossing doctrine contained in FM 5-5, *Engineer Field Manual: Troops and Operations*, was an improvement over previously available literature, but did not provide enough detail at the tactical level. The manual included general instructions on planning, command and control responsibilities, equipment characteristics, reconnaissance, and site selection. However, doctrinal writers made no attempt to flesh out the problems encountered in the support of tactical river crossings.

The prescribed doctrine viewed a crossing as an end in itself, rather than as a means to accomplish a definite wartime objective.

No plans were made to continue the attack once the crossing was achieved. Was the whole operation supposed to grind to a halt once the river was crossed, leaving a complacent bridgehead vulnerable to counterattack? To the detriment of soldiers in the field, plans for securing initial, intermediate and final objectives were not included in the 1941 doctrine.[31]

Combined arms coordination is critical to the success of military operations, a fact not unrecognized in 1941. But the 1941 manual scarcely addressed instructions on how engineers should fit into the combined arms team. For example, the preparation of engineer estimates, the allocation of assembly areas within the division's sector, the incorporation of engineer units into the communications net, and the use of a deception plan were just a few of the techniques that were absent from engineer doctrine in 1941.[32]

The same manual also lacked detailed instructions for the assault phase of a crossing, whereby the infantry secured the far shore prior to the construction of rafts and bridges. Probably the most difficult phase of a crossing operation, the assault is normally conducted under direct enemy fire. Timing, speed, and organization are critical to the operation's success. Hence, extremely detailed engineer planning in shore party organization, timetables, boat crew breakdowns, far shore objectives, ferry round-trip times, marked routes, and other techniques were expected to be addressed in tactical manuals. In 1941, two pages of general instructions addressed the assault phase, whereas ten pages were used in the 1943 manual.[33]

Further, details on control and coordination measures to direct the actions of the crossing units were practically nonexistent in the 1941 text.[34] Interestingly, these measures were discussed in Captain Hoge's after-action reports in 1918, but were not incorporated in later texts. Coordination measures are necessary to ensure that the maneuver force knows the plan for linking up with the engineers, the location of key crossing assets, assembly areas, and routes to and from the crossing sites. Without these procedures, the probability of disorganization and mission failure increases considerably—even for the simplest operation.

The lack of doctrinal coordination measures was a sure sign that both engineer and maneuver units were operating with the cards stacked against them. In 1941, a mere thirteen pages were used to describe an extremely complex operation that had already been described earlier in voluminous detail by American and German engineers with combat experience.

In 1943, finally, the Corps of Engineers developed viable river crossing doctrine. The new manual, FM 5-6, *Engineer Field Manual: Troops and Operations*, fully incorporated many of the detailed tactical procedures that were missing from the 1941 publication. For the first time, the manual differentiated between conducting hasty and deliberate river crossing operations.[35] It also outlined initial, intermediate, and final objective phases of a crossing. Unfortunately, it was made available to the field only after American forces had been deployed. Had the manual been published earlier, units—both engineer and infantry—could have familiarized their soldiers with these techniques under training conditions. As it was, most had to learn the hard way—under enemy fire.

The 1943 manual also provided detailed instructions for conducting the assault phase of river crossings. Initial assembly areas were added to assist in the control of traffic movement to the crossing sites. Traffic control plans were assigned with specific routes of march, a time sequence for group assembly areas, and specific frontages designated for boat groups. Specific boat battle drills were added to the doctrine specifying boat crew conduct, boat navigation, paddling techniques, and loading/unloading procedures. The techniques of successive trips were discussed, and concentrated on the responsibilities of engineer guides for the return boat trips.[36]

In addition to specific tactical instructions, the manual also provided engineer planning data for river crossing operations at the division and corps levels. It specified the quantity of bridge equipment and the number of engineer units required to support different types of infantry and armor units. It also included construction and crossing times to assist the maneuver commander in planning his operation.[37]

The manual was refined in 1944 with the addition of instructions for the use of heavy weapons companies in lead battalions to provide supporting fires at the river.[38] It also addressed the use of specialized equipment, like bangalore torpedoes, to facilitate the passage of obstacles during the assault wave. It also continued to update the engineer time tables for bridge construction, equipment use, and ferrying operations.

A historical review of official doctrine clearly reveals that the Corps of Engineers did not develop effective or timely river crossing doctrine during the period 1918 to 1944. While many tactical insights were readily available from both American and German engineers with significant combat experience, none gave birth to badly-needed initiative or forethought among those responsible for such doctrine.

While those insights were available in many informal forms—magazines, after-action-reports, and books—this did not ensure that the knowledge would be incorporated into the Army mainstream. Such experience was often gained at a great cost in human lives, and the loss of such experience weighed heavily on the combat readiness of Army engineers.

Have we developed viable river crossing doctrine to meet the demands of modern tactical operations? Indeed, a hard look at the doctrine in FM 90-13, TC 90-13-1, and FC 90-13 reveals areas that could be addressed in greater detail. For example, the current concept of conducting the assault phase solely with armored personnel carriers (APCs) presents itself well on paper, but cannot be the rule for all river crossings. Far shore bank conditions can often preclude or seriously hamper the use of APCs. Too, dismounted infantry is often needed to breach obstacles and secure difficult terrain prior to the movement of APCs. Moreover, in a full mobilization, many combat units may find themselves short of their full complement of APCs.

So, before we become complacent in our satisfaction with current doctrine, let's take a lesson from the past. I submit that we need to consistently review a wide variety of writings—including foreign publications—on engineer operations, promptly process experiences from the field, and rapidly produce draft doctrinal publications for review. In addition, greater institutionalization of combined arms tasks can be accomplished by assigning doctrinal proponency to specific combat units. Only through painstaking effort and consistent command emphasis can we ensure that there will never be another Rapido.

Captain Toguchi is a history instructor at the U.S. Military Academy. He previously served two successive tours as a company commander with the 237th Engineer Combat Battalion and the 502nd Engineer Company. He has also served as a battalion S-4, and assistant division engineer. He is a graduate of West Point.

Notes:

[1] Martin Blumenson, *Bloody River: The Real Tragedy of the Rapido,* (Boston: Houghton Mifflin Company, 1970), p.83.

[2] Ibid. 82-85.

[3] Ibid. 87.

[4] Ibid. 110.

[5] Ibid. 71-111.

[6] Jay Luvaas, "Some Vagrant Thoughts on Doctrine," (March 1986): 56.

[7] Department of the Army, *Dictionary of United States Army Terms* (Washington, D.C.: Government Printing Office, 1950), p. 78, as quoted in Jay Luvaas, "Some Vagrant Thoughts On Doctrine," (March 1986): 56.

[8] Training Regulations (TR) 10-5. *Military Training,* War Department. (Washington D.C., 10 August 1935), p. 1.

[9] G.B. Troland, "Decade of Progress in Military Engineering," *Military Engineer* 20 (November-December 1928): 524-525.

[10] Captain J.C. Duane, *Manual for Engineer Troops* (New York: D. Van Nostrand, 1862), p.1.

[11] Ibid. 7-33.

[12] Office of the Chief of Engineers, *Engineer Field Manual,* Part II. Professional Papers No. 29. (Washington D.C.: Government Printing Office, 1904).

[13] Office of the Chief of Engineers, *Engineer Field Manual,* Parts I-IV. Professional Papers No. 29. 4th revised edition, with addenda. (Washington D.C.: Government Printing Office, 1917).

[14] Kohloss, "The Status of Pontoon Bridge Development," p. 1.

[15] War Department, *Corps of Engineers, General Provisions.* AR 100-5. (Washington D.C.: Government Printing Office, 1942), pp. 1-3.

[16] War Department, *Report of the Chief of Engineers.* Office of the Chief of Engineers (Washington D.C.: Government Printing Office, 1921), p. 3-4.

[17] Blanche D. Coll, Jean E. Keith, and Herbert H. Rosenthal, Report of the Chief of Engineers, Office of the Chief of Engineers (Washington, D.C.: Government Printing Office, 1921), p. 3-4.

[17] Blanche D. Coll, Jean E. Keith, and Herbert H. Rosenthal, *The Corps of Engineers: Troops and Equipment* (Washington D.C.: Office of the Chief of Military History, 1958) p. 4.

[18] William M. Hoge, *Engineers in the Crossing of the Meuse River* (Ft. Leavenworth, KS: Command and General Staff School, 1918), pp. 1, 5-6.

[19] Ibid. 1-18.

[20] Colonel R.R. Ralston, "Engineer Duties in the Field in War," *The Military Engineer* 12 (January-February 1920): 67-80.

[21] Colonel R.R. Ralston, "Engineer Duties in the Field of War," The Military Engineer 12 (January-February 1920): 67-80.

[22] Ibid. 75.

[23] Ibid. 73.

[24] Mark Skinner Watson, *Chief of Staff: Prewar Plans and Preparations* (Washington D.C.: Historical Division, 1950), pp. 23-25, 35.

[25] Office of the Chief of Engineers, *Engineer Field Manual,* Military Engineering, Volume II. (Washington D.C.: Government Printing Office, 1932)

[26] Captain Paul W. Thompson, "Engineers in Battle," The Military Engineer 33 (January-February 1941): 1-5.

[27] Ibid. 1-5.

[28] Ibid. 1-5.

[29] Major Paul W. Thompson, *Modern Battle* (Richmond, Virginia: Infantry Journal, 1941), p. 1-209.

[30] Major Paul W. Thompson, *The Army Engineers,* (New York, N.Y.: W.W. Norton, 1942); *Engineers in Battle,* (Harrisburg, P.A.: Military Service Publishing Company, 1942).

[31] Office of the Chief of Engineers, *Engineer Field Manual: Troops and Operations,* FM 5-5 (Washington, D.C.: Government Printing Office, 1941), pp. 252-261.

[32] Ibid. 252-261.

[33] Ibid. 252-261.

[34] Ibid. 252-261.

[35] Office of the Chief of Engineers, *Engineer Field Manual: Operations of Engineer Units.* FM 5-6 (Washington D.C.: Government Printing Office, 1943). pp. 85-87.

[36] Ibid. 85-97.

[37] Ibid. 116-124.

[38] Office of the Chief of Engineers, *Engineer Field Manual: Operations Of Engineer Units.* FM 5-6 (Washington, D.C.: Government Printing Office, 1944), pp. 1-15.

Initial Observations By Engineers in the Gulf War

By Vernon Lowrey

The Desert Storm victory depended heavily on massive engineer support. Engineers constructed hundreds of miles of main supply routes (MSRs), logistics facilities and base camps, airfields, landing pads and aviation maintenance facilities, combined arms training facilities for maneuver units, and several prisoner-of-war camps.

They also played a critical role in general defense planning to thwart incursion of Iraqi forces into Saudi Arabia. Engineers dug in maneuver units, and provided force protection and camouflage. They provided updated maps and topographic imagery for fighting forces, trained units in breaching Iraqi defenses, and accomplished countless other preparatory tasks for both American and allied forces.

And just before Desert Storm forces crossed Iraqi lines, engineers cleared gaps in the enemy's complex obstacle belts. When the attack began, engineer soldiers were well forward with covering force and scout units.

Engineers fire a MICLIC (mine clearing line charge) during Operation Desert Storm. The MICLIC appeared to suffer from several shortfalls during the Gulf War (U.S. Army photo).

Following the allied victory, engineers cleared MSRs deep into Iraqi territory, allowing supplies to keep up with maneuver units. Sappers cleared wide areas of unexploded mines and other ordnance, and destroyed vast quantities of captured Iraqi facilities, vehicles, weapons and munitions.

After the cease fire, engineers constructed redeployment bases, and assisted in the initial reconstruction of Kuwait. Engineer forces continue today to assist war refugees, and are working to restore Saudi facilities and roads.

Observations

The Gulf War clearly showed that certain engineer problems, identified since World War II, continue to be a source of concern, including countermine/counterobstacle operations, and the engineer force structure for the heavy divisions. The operation also showed that the recent procurement of new engineer equipment, like the M9 armored combat earthmover (ACE), the small emplacement excavator (SEE), and the full-width combat engineer vehicle mine rake (CEV), were wise choices—and invaluable to the success of the operation.

Nothing "new" has really been gleaned from the operation, and the engineer community seems to be on track with the refinement of current engineer doctrine, training, organization, materiel and leader development.

The following are ten major engineer observations from Operations Desert Shield and Desert Storm. The commandant of the Engineer School has passed them on to the Center for Army Lessons Learned to be used for further study and development. These are only observations, and will become official "lessons learned" only after they have been analyzed. There are many observations currently under study, and these are some of the more important ones.

1. OBSERVATION: Formation of "regimental engineer" organizations in heavy divisions.

> ***"The regimental engineer organization... allowed the regimental engineer staff to be an integral part of the decision cycle, rather than just reacting to it."***

DISCUSSION: Regimental engineer force structures were created in four of the five heavy divisions deployed to Saudi Arabia. The regimental engineer organization consisted of a headquarters detachment and three engineer combat battalions—one associated with each maneuver brigade. Engineer planning took place inside the maneuver commander's decision cycle. This allowed the regimental engineer staff to be an integral part of the decision cycle, rather than just reacting to it. The time freed up by efficient engineer planning and operations allowed maximum use of mobility, countermobility, and survivability operating systems. For the first time, maneuver commanders were able to mass engineers at the point of application.

RECOMMENDATION: Continue to form regimental engineer organizations in each heavy division, as approved by the Army chief of staff in April 1991.

2. OBSERVATION: The M9 ACE worked well.

DISCUSSION: Desert Storm provided the first hard evaluation of the M9 ACE. Though not intended as an assault breaching vehicle —hence its light armor protection—the ACE proved to be a success in breaching obstacles that were not covered by fire. The ACE remained well forward, and was available for task force operations when required. ACE missions included knocking down Iraqi berms, constructing friendly survivability positions, and digging trenches for the destruction of captured munitions. Its mobility was also a key factor, because it did not require the additional transport vehicles normally associated with bulldozers. Commanders commented that the ACE needs an additional crewman and a weapons system such as the .50 caliber machine gun, or the Mark 19 automatic grenade launcher.

RECOMMENDATION: The M9 ACE should continue to be fielded in sufficient quantities in all combat engineer companies. ACE training needs to be emphasized in the future. The concepts of a weapons station, blade design, engine improvement, and two-man crew need further study.

3. OBSERVATION: The overall breaching capabilities of engineer forces must be improved in order to provide effective mobility support.

DISCUSSION: Iraq developed formidable, complex obstacle systems to blunt penetrations into Kuwait by allied forces. The U.S. Army and its allies responded with several existing systems, and quickly developed other, mechanical obstacle-reduction methods. In addition, a combined arms breaching doctrine, described in Field Manual (FM) 90-13-1, was implemented, rehearsed, and successfully executed.

On the whole, complex obstacle breaching was not conducted under fire. If this had been the case, the breaches would have been more difficult because of the numerous systems and methods in use. Desert Storm revealed that the current (essentially World War II vintage) breaching and clearing capabilities—along with a lack of demolition expertise—severely limited our ability to breach modern mine fields.

The modern conventional mines now employed by Third World countries are more sophisticated than our own. They contain magnetic, double impulse, and seismic fuses, along with anti-disturbance devices. They also contain little or no metal, and most mine detectors are ineffective in locating them.

The sophistication of these mines also makes the use of grappling hooks, bangalore torpedoes, and mine probes a very hazardous proposition. Other mechanical and explosive breaching methods proved slightly faster, but were limited in numbers and success. The mechanical systems lacked the mobility and protection required to provide responsive support to maneuver forces, and only managed a cursory obstacle reduction capability.

An Iraqi minefield on the Kuwaiti coast. While Iraq built formidable obstacles on both the southern and coastal borders of Kuwait, Desert Storm engineers successfully breached them using current combined arms breaching doctrine (U.S. Army photo).

Breaching by Air Force bombing was ineffective. Bombing patterns did not provide a straight lane, and made proofing with plows and rollers difficult and ineffective. Such bombing also left metal fragments which interfered with mine detection, and left dud bombs which had to be cleared.

Once a breach was established, breach lane marking was ineffective. There were no standard marking systems identified in the theater. The cleared lane marking system (CLAMS), and the hand-emplaced minefield marking system (HEMMS) proved ineffective for most units, and were seldom used. Both systems proved difficult to see at night. The HEMMS could not be easily deployed from the rear of lead vehicles in breach lanes, and the CLAMS was often covered by sand from passing vehicles.

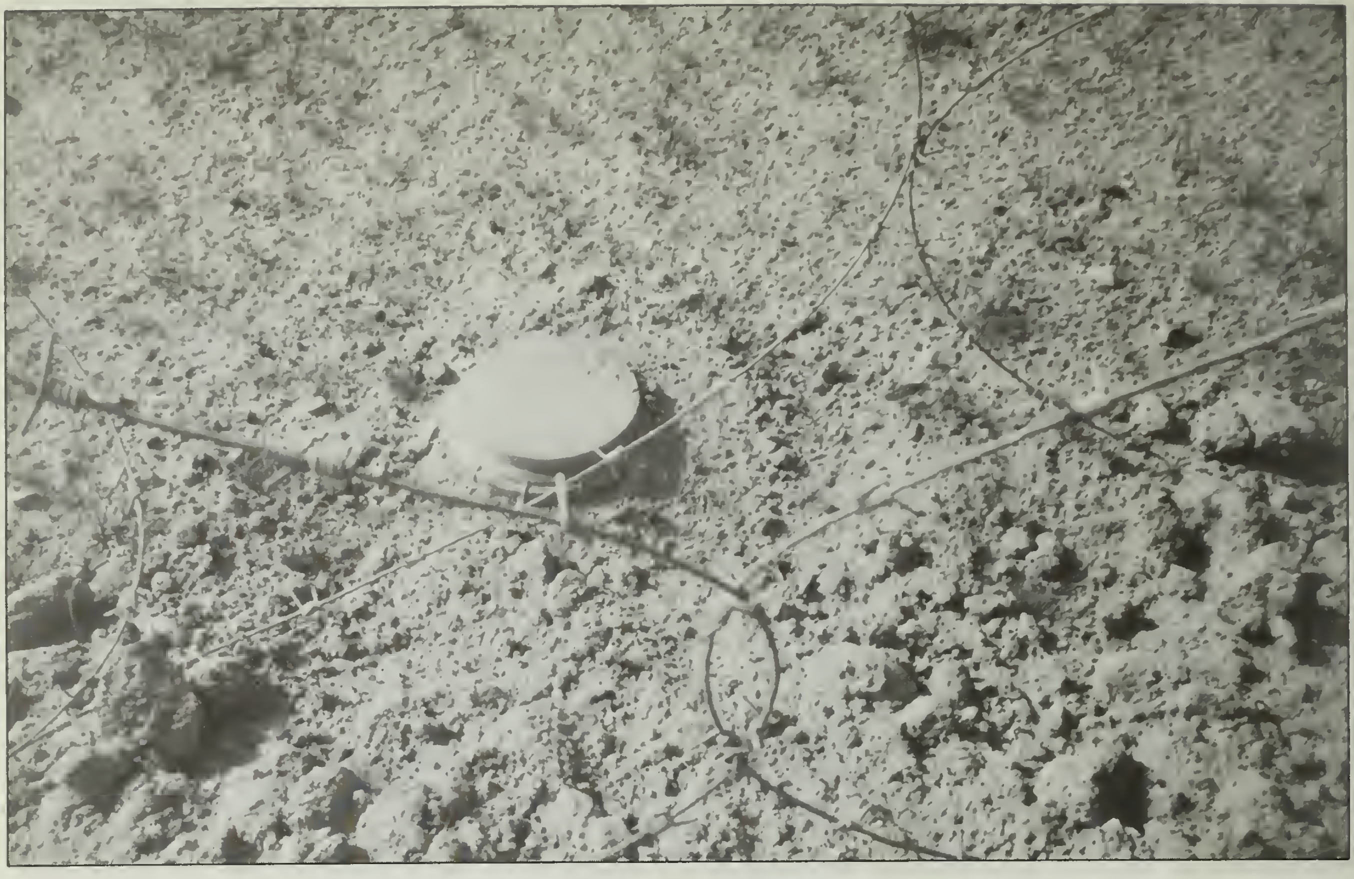
Descriptions of several mechanical obstacle reduction systems and comments on their effectiveness follow:

Mine Clearing Line Charge (MICLIC). The MICLIC had several shortfalls. Numerous firing failures occurred during live fire training, involving both the trailer firing circuits and rocket/line charge circuits. Test firings prior to the start of hostilities resulted in a 50 percent failure rate (primarily due to unfamiliarity with the system, inadequate training prior to arrival in theater, and production quality control).

Additionally, the MICLIC only attacks the mine fuse—not the mine itself. As a result, it was only effective against single, short-impulse, pressure-fuzed mines that were surface-laid, or buried 10 inches or less below the surface. The system also left "skip zones" (0.75 meter (m) to 1.5m) on both sides of the centerline, where mines escaped destruction from overpressure blast. Mines with other types of fuzes were not affected by the MICLIC.

The unarmored MICLIC trailer, towed by armored vehicles, suffers from a lack of survivability and mobility that hinder the usefulness of the system.

Mounting the MICLIC on an armored vehicle launched MICLIC (AVLM) provided more survivability, but did little to help other operational problems. The AVLM is a modified AVLB (armored vehicle launched bridge) chassis with two MICLICs on the rear deck. Commanders planned for their use as part of deliberate breaching operations, but left them behind once the initial breach and pursuit were initiated. Simply put, the older M48/M60 chassis was unable to keep up with the M1s and M2s of the maneuver forces.



An Iraqi mine in southern Kuwait. These mines are much more sophisticated and versatile than our own, and contain magnetic, double impulse, and seismic fuses—along with anti-disturbance devices (U.S. Army photo).

Another logistical limitation was imposed by the 100m length, or effective range of the system. Commanders found that several MICLICs were required for breaching complex obstacles.

The Combat Engineer Vehicle (CEV). Engineer forces conducting breaching operations with the CEV found that the vehicle was unable to keep up with maneuver forces—diminishing its value to the operation. The CEV also had maintenance delays because it is built on the M48/M60 chassis and spare parts were not readily available in a theater where most U.S. tanks were M1s.

The CEV Full-Width Mine Rake. This rake is a non-developmental item developed and fielded specifically for use in Desert Storm. The rake is suited only to a dry sand environment, giving it a very narrow usefulness. The rake was normally employed after a MICLIC firing to proof and clear a lane. Because the rake was designed to remove only antitank mines, antipersonnel devices slipped through the tines. Once the deliberate breaching operation was completed, commanders left them behind. Overall, the rake worked well during Desert Storm.

Countermine Sets (Mine Rollers and Mine Plows). Extensive training and rehearsal with mine rollers and mine plows took place during Desert Storm. Prior to this, countermine sets received little more than "lip service" from the maneuver community.

The use of tank-mounted mine plows for lane clearing or breaching proved to be very effective against surface-laid and scatterable mines. The plows were effective at punching through the Iraqi sand berms and clearing minefield lanes for the tanks.

Mine rollers, however, were judged by armored forces to be ineffective and cumbersome.

Overall, Desert Storm validated the value of mine breaching systems mounted on fast, survivable vehicles. The most effective system will depend on the tactical situation, but the need for the capability is clear.

Others. Other means of reduction not addressed here included the ACE, the AVLB, and manual techniques (grappling hooks, probes, and bangalore torpedoes).

RECOMMENDATION: The mechanical reduction methods now in use need to be replaced by a system that will provide the AirLand Battlefield maneuver commander with a highly mobile and effective obstacle reduction capability. That system is the combat mobility vehicle (CMV). The CMV is highly mobile, survivable, and can be very effective in the reduction and clearing of complex obstacles—without the aid of other mechanical or manual reduction means.

The CEV should be replaced by the CMV. There must be four CMVs per company, supporting a maneuver task force (two per breached lane). The CMV needs a crew of at least two soldiers in order to conduct 24-hour operations.

Current countermine sets should remain with armored forces as a self-extraction capability. Mine rollers should remain in the force for use in terrain other than that found in the Persian Gulf region.

Additionally, we need an improved or modified MICLIC to correct the identified deficiencies. The MICLIC must be mounted on a survivable vehicle that can keep up with the supported maneuver units. Live fire exercises for the MICLIC must be included in the Combined Arms Training Strategy (CATS). Adequate resources must be provided by the Standards in Training Commission (STRAC) to support live firing by engineer forces. Live fire training sites must be identified for the MICLIC and similar systems.

Standoff minefield detection systems, remotely operated breaching devices, and a standardized, simple, and durable minefield marking system need to be developed. Live mine training must be emphasized in order for soldiers and leaders to gain sufficient skill and confidence.

4. *OBSERVATION:* Gap crossing with the AVLB-M48/M60 chassis.

DISCUSSION: The AVLB continues to be a viable means of crossing gaps of 18 meters or less. However, there are major mobility and survivability concerns. The AVLB is mounted on an outdated M48 or M60 chassis that cannot keep up with main battle tanks or infantry vehicles, and can't offer the same degree of protection.

RECOMMENDATION: As we continue to rely on AVLBs for crossing short gaps, we must begin to mount the system on the M1 chassis. This will give the AVLB the mobility it needs to support rapidly advancing maneuver units.

5. *OBSERVATION:* Combat engineers mounted in M113s or 5-ton dump trucks could not keep pace with maneuver forces.

DISCUSSION: Once maneuver forces broke through initial Iraqi defenses and advanced rapidly to the north, combat engineers in outdated and slow vehicles were left lagging behind. Engineer units require mobility and protection commensurate with that of supported maneuver forces. They must be agile enough to respond to the needs of maneuver units as the situation develops—not afterwards. This lack of mobility degraded the capability of engineers to respond to missions during the attack. The required level of engineer protection was not adequately assessed in this operation.

RECOMMENDATION: The current divisional mechanized combat engineer squad M113 should be replaced with a modified version of the M2 infantry fighting vehicle—making it a "sapper vehicle." Since the M2 turret is not required for the engineer mission, it should be replaced with a commander's machine gun station. Removing the turret also allows increased internal storage for squad equipment and munitions.

M2s and M113s could be transferred from deactivated divisions for use as sapper vehicles. Not all mechanized engineers would be able to receive M2s, so M113s should be allocated to lower priority units. Corps combat engineer squads that support mechanized forces should also receive M113s.

6. *OBSERVATION:* The M548 tracked ammunition carrier could not keep up with heavy forces.

DISCUSSION: The M548 is the prime mover for ground emplaced mine scattering systems (GEMSS) and the upcoming VOLCANO mine system. Because of its relative slowness, the carrier normally moves with combat trains instead of maneuver elements.

RECOMMENDATION: Replace the M548 with a vehicle providing enhanced speed and survivability for the GEMSS and VOLCANO.

7. *OBSERVATION:* Before the start of gulf operations, realistic training on complex obstacle breaching was not conducted at the combat training centers (CTCs).

DISCUSSION: When it became apparent that allied forces would have to breach a complex obstacle system in order to retake Kuwait, a serious deficiency in unit training was discovered. Units traveling to the CTCs had not practiced complex obstacle breaching. In fact, units at the NTC did not have rollers or plows, and MICLIC trainers were not being used.

This resulted in a last-minute effort to train units in the complicated breaching operation, along with the organization and equipment necessary to support it. If the CTC program had operated as planned, realistic threat training would have been in place.

RECOMMENDATION: Units training at the CTCs should train to standards. The threat should be accurately portrayed and breaching operations should be conducted in accordance with FM 90-13-1. Because breaching, like bridging, is an extremely complex task, units must keep their skills current so they will be better prepared to conduct this operation.

8. *OBSERVATION:* Current conventional mine stocks need to be modernized. Inventories of scatterable mines must be expanded to meet contingency requirements.

DISCUSSION: Foreign conventional mines are complex, yet highly effective and versatile, highlighting the obsolete nature of our own mine stocks. Had the roles been reversed, it would have been far easier for the enemy to breach our obstacles. Overpressure protection, advanced fuzing, and anti-handling features make foreign mines an attractive alternative to our current stock of conventional mines.

Existing stocks of scatterable mines did not meet theater requirements. Europe-based battalions were the only units with GEMSS equipment. Artillery-delivered scatterable mines have not been produced in sufficient quantities to meet anti-personnel and anti-tank requirements. Marine requirements also put a strain on the limited availability of these mines. Only two Air Force scatterable minefields were employed.

RECOMMENDATION: Replace current conventional mine stocks with modern models. Adopt a common-fuzed mine which has the flexibility of performing any of the current mine functions. Provide a capability for remotely arming/disarming/self-destructing these mines. Increase production and fielding of scatterable mines and their delivery systems to meet future contingency requirements.

9. *OBSERVATION:* Engineers need a hardened ambulance for casualty evacuation on the battlefield.

DISCUSSION: Currently, the mechanized engineer battalion is authorized only one soft-skinned ambulance. Mechanized engineer companies must have an armored, tracked ambulance in order to evacuate casualties from the battlefield. Area evacuation doesn't work because of the size of the battlefield and the number of casualties. Maneuver units were forced to give up their own M113 ambulances in support of engineers conducting breaching operations.

RECOMMENDATION: Authorize an M113 ambulance in each mechanized engineer company.

10. *OBSERVATION:* Topographic survey support and map production failed to meet the requirements of units at corps level and below.

DISCUSSION: Gulf operations showed the need for new and updated topographic capabilities. Existing control points for corps artillery were of questionable accuracy, since they were established from local datums or by unknown procedures. The nature of the gulf region emphasized the need for automated, integrated survey instruments (AISI) and the global positioning system (GPS) to provide positioning and navigation for engineers.

Rapid, down-sized, and tailored map production capabilities are also needed to support tactical commanders at division level and below. This capability is currently available with non-developmental items of equipment, but these systems are not tactically feasible because of special handling and power requirements.

RECOMMENDATION: Topographic survey capabilities should be retained in the force structure to allow engineers to map and update potential contingency theaters. Geodetic-quality GPS systems should be fielded to topographic units for survey purposes. Compact, rugged equipment needed at the division level includes a down-sized digital topographic support system (DTSS), digital cartographic integrated information system (DCIIS), and quick response multi-color printer (QRMP). This equipment should be mounted on a high mobility, multi-purpose, wheeled vehicle (HMMWV) to provide better support to the maneuver commander.

Mr. Lowrey is chief of the Engineer School's Analysis Division, Directorate of Evaluation and Standardization. He previously served as primary action officer for the E-Force and Engineer Restructure Initiative for the directorate. As an Army National Guard major, he also serves as S-3 of Missouri's 1138th Engineer Combat Battalion. Previous military assignments include company commander, platoon leader and S-1. He holds a bachelors degree from Colorado State University.

Engineer Solution

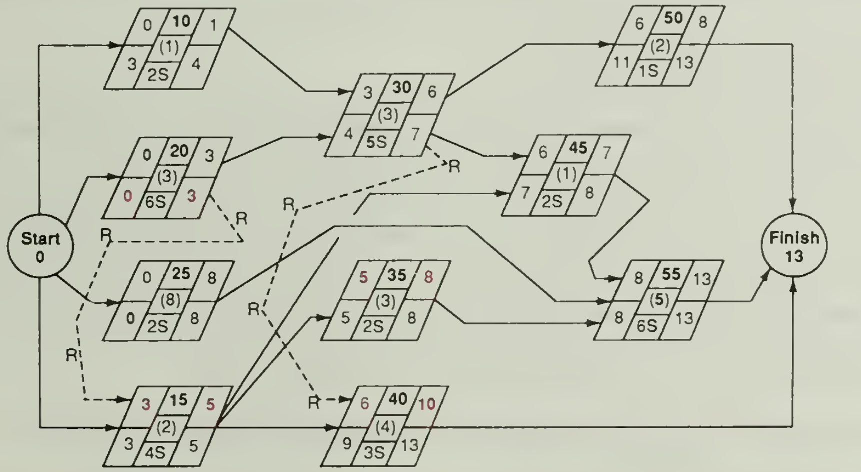
PART I: Resource Constrain The Early Start Schedule

After constraining the early start schedule, we find there are two resource delays (R) and one logic delay (L). Activity 15 cannot start until the resource from activity 20 becomes available. When delayed, activity 15 moves into interfering float. This causes a logic delay of three days for activities 35 and 40. When time period 6 is constrained, we find that activity 40 must be delayed one additional day for insufficient resource. The resource needed for activity 40 must come from activity 30.

Network Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
10 (30)	2S			☒																	
15 (35, 40, 45)				4S	4S	R															
20 (30)	6S	6S	6S	☒																	
25 (55)	2S	2S	2S	2S	2S	2S	2S	2S													
30 (45, 50)				5S	5S	5S	☒														
35 (55)						2S	2S	2S	L												
40							3S	3S	3S	3S				R							
45 (55)							2S														
50							1S	1S													
55									6S	6S	6S	6S	6S								
Squads (S)	~~14~~	~~12~~	~~13~~	~~12~~	~~12~~	~~10~~	~~5~~	~~3~~	~~6~~	~~6~~	6	6	6								
	10	8	8	11	11	9	10	8	9	9											

PART II: Update The Logic Network

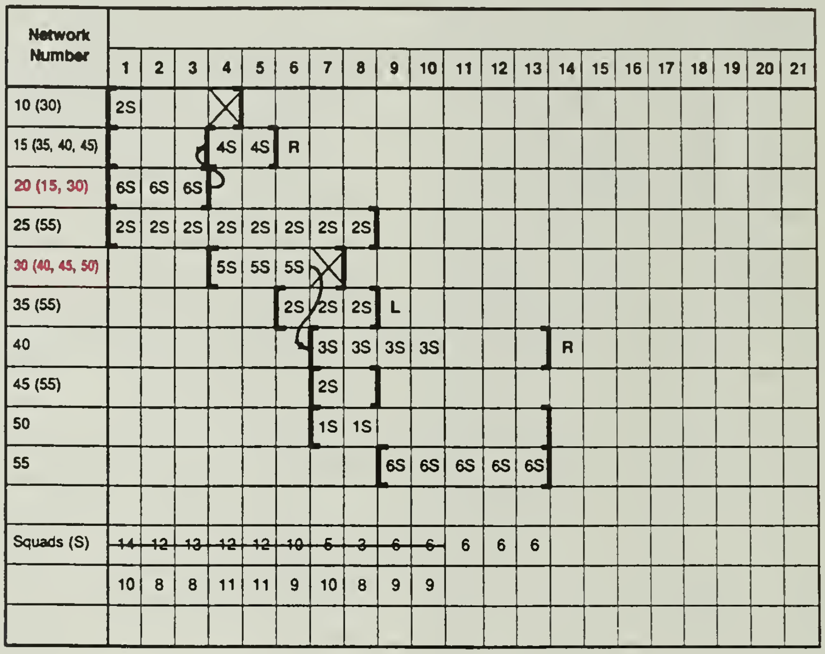
We incorporated the two resource flow arrows into the logic network by drawing dashed arrows and a superimposed "R". This established two new paths in the network and changed the time analysis. The updated network and time analysis are shown below. Changes in the time analysis are annotated in red.



Engineer Solution

PART III: Update The Early Start Schedule

The changes made in the logic network must be incorporated into the early start schedule. After updating the activity numbers (Step 10), time frames (Step 11) and float calculations (Step 12), we prepared the following early start schedule. Activity numbers that changed are shown in red. Time frames (early start and/or late finish) changed for activities 15, 20, 35 and 40. Interfering float calculations did not change for the activities with float (activities 10, 30, 40, 45, and 55).



Network Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
10 (30)	2S																				
15 (35, 40, 45)				4S	4S	R															
20 (15, 30)	6S	6S	6S																		
25 (55)	2S	2S	2S	2S	2S	2S	2S	2S													
30 (40, 45, 50)				5S	5S	5S															
35 (55)						2S	2S	2S	L												
40							3S	3S	3S	3S				R							
45 (55)							2S														
50							1S	1S													
55									6S	6S	6S	6S	6S								
Squads (S)	~~14~~	~~12~~	~~13~~	~~12~~	~~12~~	~~10~~	~~5~~	~~3~~	~~6~~	~~6~~	6	6	6								
	10	8	8	11	11	9	10	8	9	9											

Summary. At this point we have constrained the resources for the project. Three additional activities (20, 15 and 35) have become part of the critical path. Critical activities are defined as activities with zero float. None of the changes resulted in any activity being delayed beyond its late finish (right bracket). Therefore, the project duration will not change.

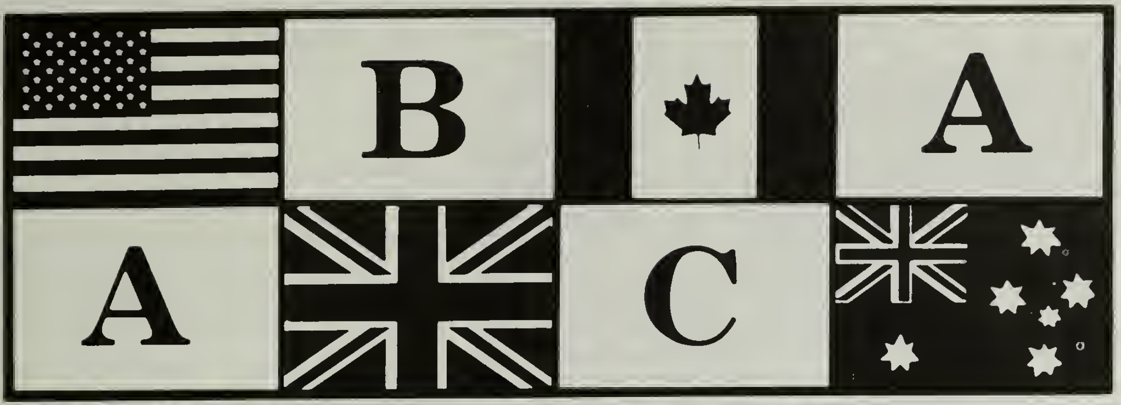
Notes: The step-by-step procedure described in this problem will produce a solution to the resource problem. If this technique results in project delays that are unacceptable, there are two variations the manager can use to select activities to delay (Step 2).

The first variation is to delay the early start of an activity that is ongoing, but does not begin, during the time frame identified in Step 1. In some cases this option provides a better solution to the resource problem. The procedure used is the same, except that the first activity delay will be greater than one time period.

The second variation is to delay part of an activity (splitting an activity). This option requires that you redefine the logic network and make two activities out of one. You must add the new activity to the early start schedule.

A project manager can use these techniques after he or she fully understands the basic technique described in Step 2. For any project with insufficient resources, the project manager must ultimately decide which activities to delay. An understanding of the intricate interaction between each activity will enable the manager to make informed decisions and successfully complete the project.

This problem was submitted by Captain Earl Hooper, an instructor in the Combat Construction Division, Department of Instruction, U.S. Army Engineer School.



The Quadripartite Working Group:

Honing Engineer Standardization

By Captain Kathryn M. Ohmann

Operation Desert Storm engineers are still sifting through the lessons of the Gulf War, but one thing they know for sure: The standardization of allied engineer equipment, tactics and procedures was critical to the swift victory over Iraq.

That's the word from engineer officers from four coalition nations—the United States, United Kingdom, Canada and Australia—who recently met at Fort Leonard Wood for the 10th Quadripartite Working Group on Engineers (QWG Engr).

Background

The QWG is part of the American-British-Canadian-Australian (ABCA) Armies Standardization Program, initiated shortly after the end of World War II. Its origins can be traced directly to the close working relationship of the Allies during World War II. Within two years after the war's end, General Eisenhower and Field Marshall Montgomery sought to maintain the hard-earned interoperability between British and American forces by implementing the "Plan to Effect Standardization" in 1947. The plan, supported by Canada as well, had two basic purposes: minimize materiel or technical obstacles to full wartime cooperation among the armies concerned, and maximize economy of resources and effort. In the following years, equipment began to appear in the three armies with the designation ABC preceding the model and nomenclature of the item, indicating an operational commonality.

By 1963 Australia joined the effort, and the program was ratified by the current agreement, called the Basic Standardization Agreement 1964 (BSA 1964). New Zealand initiated cooperation with the ABCA in 1965 and, though not a signatory to the BSA, maintains close ties with the organization.

Working under the authority of BSA 1964, the aims of the ABCA are to:

- Ensure cooperation and collaboration among the ABCA armies
- Achieve the highest possible degree of interoperability among the signatory armies through materiel and nonmateriel standardization
- Obtain operational economies through the use of combined resources and effort

To achieve those ends, the ABCA strives to:

- Keep each army fully informed of research and development (R&D) taking place in the other armies
- Guide R&D so that it meets the requirements of all four armies
- Record and maintain formal agreements on materiel and nonmateriel items or concepts

A team of Canadian Army engineers lifts a section of bridge during a training exercise. Commonality of equipment was a significant contributing factor to the success of Operation Desert Storm .

meeting the needs of two or more armies

- Ensure that such formal agreements are not modified without consultation

At the senior level, each army gives direction to the program through quadripartite standardization discussions known as TEAL (tactics, equipment and logistics). These discussions are held in rotation among the four member countries approximately every 18 months. They are attended by officers at the vice/deputy chief of staff level—or equivalent—and their delegations. At the action level, the policy-making body is the Washington Standardization Officers (WSO). This group is composed of senior officers on duty in Washington D.C. They represent each of the member armies and collectively provide management guidance to the program by discussing policies, programs and procedures.

The WSO is supported by the Primary Standardization Office (PSO), which is composed of military representatives from each of the armies. The PSO provides the secretariat for the WSO, reviews the progress of the ABCA Program, and monitors the activities of the QWGs. This office is led by a director (colonel), provided by each of the participating countries on a rotational basis, and lieutenant colonels from each country. The lieutenant colonels are designated as the Primary Standardization Officer (PSO) for their country.

In addition to these ABCA elements, each army designates a National Standardization Officer (NSO) and appoints three Standardization Representatives (StanReps) to each of the other three armies. The StanReps' duties include liaison with the staff agencies to which they are accredited, and relaying information and reports to their own army.

QWGs

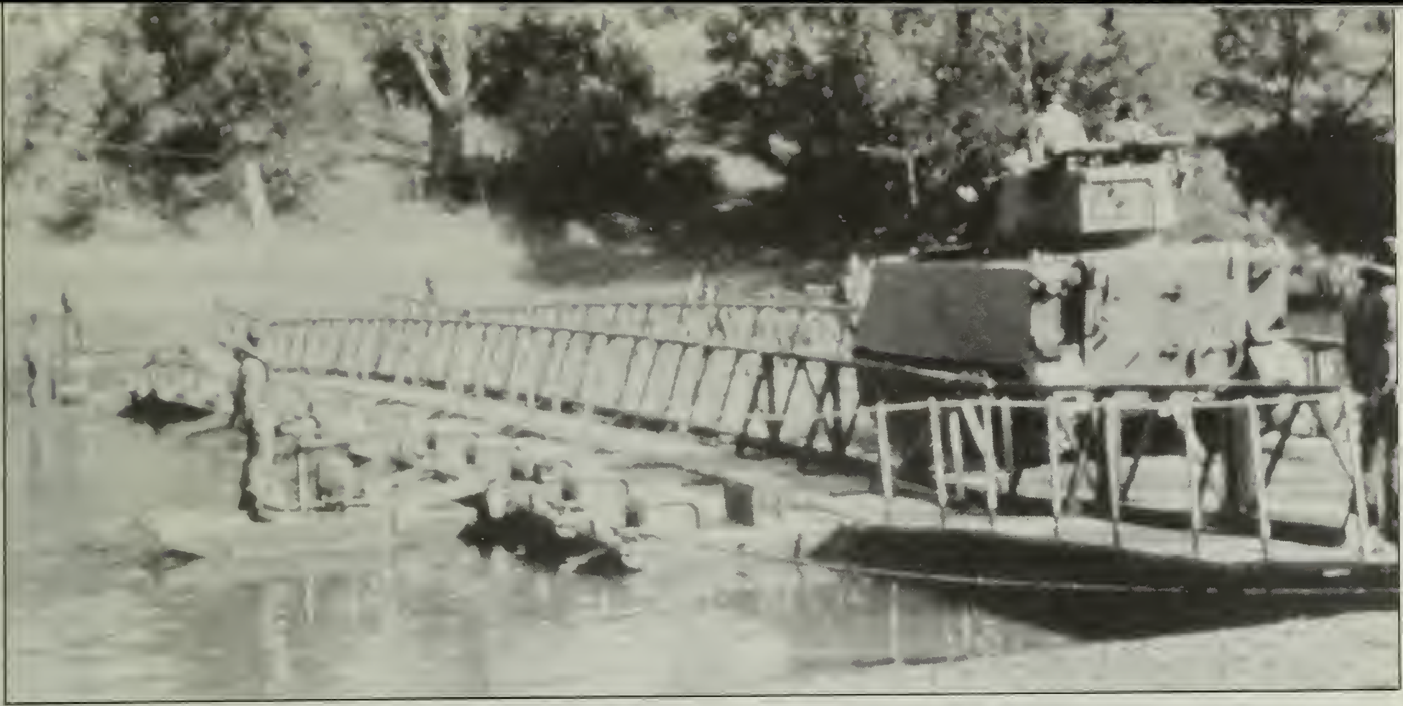
The key working elements of the program are the QWGs. Currently, 18 QWGs exist to exchange information, develop concepts, recommend areas for cooperation and standardization, develop Quadripartite Standardization Agreements (QSTAGs) and assist the WSOs to maintain the standardization progress. QSTAGs are formal agreements ultimately incorporated into "how to fight" manuals. They define the level of standardization to be achieved in materiel and non-materiel fields.

The current QWGs are: Engineers, Engineering Standardization, Air Defense, Infantry, Armor, Intelligence, Army Operational Research, Logistics; Aviation, Nuclear-Biological-Chemical Defense, Combat Developments, Command and Control, Proofing, Inspection, and Quality Assurance, Communications and Information Systems, Surface-to-Surface Artillery, Electronic Warfare, Surveillance, Target Acquisition, Night Observation, and Health Service Support.

Most of the detailed work of standardization is conducted in the QWG forum. Experts in the appropriate fields represent their army at QWG meetings. Meeting time is used principally to resolve issues that cannot be settled by correspondence, and redirect the work of the QWG in accordance with TEAL guidance. In the time between such meetings, correspondence between national points of contact (NPOCs) carries the QWG workload.

Each QWG has a standing chairman, appointed by the WSO, who coordinates QWG business and chairs meetings. The QWG Engineer standing chairman is always provided by Australia.

In general, the role of each QWG is to:



Australian engineers conduct river crossing training using a British Class 30 aluminum bridge. Crossing the bridge is an Australian cavalry fire support vehicle, a modified version of the American M113 armored personnel carrier.

- Exchange information
- Develop concepts
- Influence requirements
- Identify areas for cooperation and standardization
- Develop standardization agreements
- Participate in the validation of standardization agreements
- Maintain the standardization level that has already been achieved
- Review appropriate sections of the standardization list (STANLIST) to ensure that it remains current in both content and application, and recommend additional items for the list

On a QWG's recommendation, special working parties (SWP) and information exchange groups (IEG) may be established to achieve, through correspondence, tasks requiring expert examination beyond the QWG's capability, and to explore other areas of potential standardization. QWG Engineer has two associate SWPs: Field Electrical Power Systems, and Mapping, Charting and Geodesy. QWG Engineer also has an IEG on Engineer Command, Control and Information Systems. These SWPs perform valuable work in their specialist areas of concern, though interoperability in both of these areas is still some way off.

10th QWG Summary

The 10th QWG Engineer was held 5-11 June 1991, at the Engineer Center, Fort Leonard Wood. Attendees included:

Standing Chairman - LTCOL K.J. Gillespie (AUS)
WSO Representative - LTCOL A.W. Ayerbe (AUS)
NSO Representative - Dr. R. Wiltshire (US)
StanRep - LTCOL E.W. Challis (AUS)
US Delegation - COL F.J. Charles III, LTC R.J. Somerville, Mr. C.F. Wassan, MAJ W.D. Johnson (USMC)
UK Delegation - Col P.B. Page, Lt Col (R) D. Silver, Maj J.P.J. O'Sullivan
CAN Delegation - LCOL D.A. Grice, Maj R. B. Nageleisen, Maj J. Hamel
AUS Delegation - COL P.C. Cooper, LTCOL P. Newman, MAJ G.O. Fenton
NEW ZL Observer - LTCOL A.T. Beaver

A special working group, composed of the QWG NPOCs, met for two days before the meeting began to discuss interoperability gaps and a plan of action. This meeting identified and prioritized areas for the QWG agenda. In many cases, the priorities were changed from the original agenda because of recent engineer developments.

Discussions continued to center on low and mid-intensity conflicts, with particular emphasis on priority tasks identified in the QWG Engineer Plan of Action. Interoperability aims were directed toward ensuring that an ABCA engineer squadron/company would be able to operate effectively as a subunit of any member nation's brigade or engineer regiment. Integration of units below squadron/company level was not considered feasible.

Concentration of work for mid- and low-intensity conflicts will probably be centered on general engineer support and engineer command, control and information systems (ECCIS). Work on ECCIS is particularly important because it's a key factor in achieving interoperability. Before the 11th QWG Engineer meets, the WSO will probably be asked to approve the formation of a Special Working Group ECCIS.

The reorganization and down-sizing now taking place in each army may well have a detrimental effect on the ABCA program. QWG Engineer decided that the current program of work should continue without amendment. However, dates for the execution of individual tasks, and perhaps the whole program, may have to be slipped as reorganizational changes take effect.

The major achievements of the 10th QWG Engineer meeting were:

- A review of the assessment of interoperability gaps and preparation of a revised plan of action
- A revision of concept papers, reference and working papers, and QSTAGs
- A major discussion of ECCIS and its role as a key factor in future interoperability
- Reconfirmation of ECCIS and general engineer support as priority areas for future work
- Confirmation of the structural changes and developments undertaken at previous QWGs
- An exchange of information and ideas

The 11th QWG Engineer is scheduled to be held in the United Kingdom in October 1992.

Achieving true interoperability between allied forces is a daunting objective. But the accomplishments of the ABCA Program proved their worth in the Gulf War, and the QWG Engineer will continue to be a vital part of those efforts.

Captain Ohmann is the information management coordinator for the Engineer School's Directorate of Combat Developments. She served as the administrative officer in charge of planning and organizing the 10th QWG Engr meeting. Captain Ohmann's previous assignments include platoon leader, adjutant and S-2 for the 29th Engineer Battalion (TOPO). She is a graduate of the Engineer Officer Advanced Course, Combined Arms and Services Staff School, and North Dakota State University.

The ENGINEER Writer's Guide

We think engineers take a special pride in their profession, and *ENGINEER* is always looking for articles from readers who want to share their expertise, experience and ideas.

If you're a potential contributing writer, here are a few "writer's guide" tips that should help steer you in the right direction:

Articles can cover engineer training, operations or doctrine, engineer equipment, history or other areas of general interest to an engineer readership.

We're especially interested in articles that have a "how-to-do-it-better" theme. For instance, we're not looking for articles telling readers how you conducted a routine field exercise. But if you think you have a "new-and-improved" way of conducting a tactical operation, training exercise, or other operational procedure that may prove helpful to other engineers—that's what we need.

Articles should generally come from contributors with first-hand experience with the subject being presented.

Avoid theatrical writing styles like: "It was a dark and stormy night...," or "...the soldier blazed through the jungle on his lumbering D7, providing a trail of freedom for the other vehicles..."

Articles should be concise, straightforward, and in the active voice.

Length should range between 2,000 and 4,000 words, and the text should be typewritten and double-spaced. Generally, each such page will contain from 200 to 250 words.

Articles containing attributable information or quotations not referenced within the story should carry appropriate footnotes.

Manuscripts must be original, unpublished, and not under consideration by another publication. Normally, you can expect a reply to your submission within two weeks after we receive it.

All submissions are subject to editing.

Contributors are encouraged to include black-and-white photos, artwork, and/or line diagrams to help illustrate your article.

Include your full name, rank, current unit and job title. Also include a list of your past assignments, experience and education, your mailing address, and daytime phone number—preferable Autovon. Send your articles to: Editor, *ENGINEER* Professional Bulletin, ATTN: ATSE-TDM-PB, Fort Leonard Wood, MO 65473-6650.

If you have any questions about an article you're working on—or considering writing—give our features editor, Phil Howell, a call at Autovon 676-7643, or commercial (314) 563-7643.

We look forward to hearing from you.

P.S.* ENGINEER *is planning to start a Letters to the Editor column soon, and correspondence from our readers is welcome.

ENGINEER UPDATE

Autovon numbers are 676-XXXX, and commercial numbers are (314) 563-XXXX, unless otherwise noted.

Directorate of Training and Doctrine (DOTD)

Topographic Division Welcomed. The Department of Topographic Engineering is reorganized as a division under the Directorate of Training and Doctrine. Office telephone numbers are the same: -5433/5435. LTC Mark Schnable, the chief, came to us from Fort Shafter, Hawaii, where he was commander, 29th Engineer Battalion (Topographic). POC is Robert Valska, -7505.

Combined Arms Training Strategy. Proposed training strategies for the combined arms training strategy (CATS) will be distributed to the field for comments by April 1992. POC is CPT Frank Barry, -7594.

DA Pam 350-38 Revision. The review process for DA-PAM 350-38, Standards in Weapons Training, has been accelerated due to issues arising from Desert Storm operations. Plans are to review field comments and produce an updated DA PAM 350-38 by the 4th quarter of fiscal year (FY) 92. POC is Rayburn Toy, -7591.

Directorate of Combat Developments (DCD)

Explosive Malfunctions. Units returning from Saudi Arabia report numerous malfunctions with demolitions, particularly with the M180 Demolition Cratering Charge. If your unit experienced problems with explosives in the Persian Gulf or in normal training, call the Engineer Hotline, AV 676-7324 or (314) 563-7324. When recording your message, include a POC (name, unit, and phone number), and the ammunition type and lot number. If possible, do not destroy the evidence. POC is SFC Leatherman or Eric McGrath -7337/7256.

Engineer Restructure Initiative (ERI). Implementation of ERI has been approved in the FY 92 FORSCOM Command Plan. This conversion will affect 11 CONUS installations. The redistribution of engineer assets within FORSCOM includes heavy divisional battalions, corps mechanized battalions, and separate engineer companies. POC is Pete Malley, -7243.

Engineer Center Welcome Packets. Students scheduled to attend professional development courses at the Engineer Center should receive welcome packets before they come to Fort Leonard Wood. Students who do not receive a welcome packet 30 days prior to their scheduled report date should request one by calling the appropriate office:

- Engineer Officer Basic or Advanced Course (EOBC/EOAC) - AV 581-4367, (314) 596-4367.
- Primary Leadership Development Course (PLDC), Basic or Advanced Noncommissioned Officer Courses (BNCOC and ANCOC) - AV 581-2419/6334, (314) 596-2419/6334.

POC is Bob Clark, -5320.

Directorate of Evaluation and Standardization (DOES)

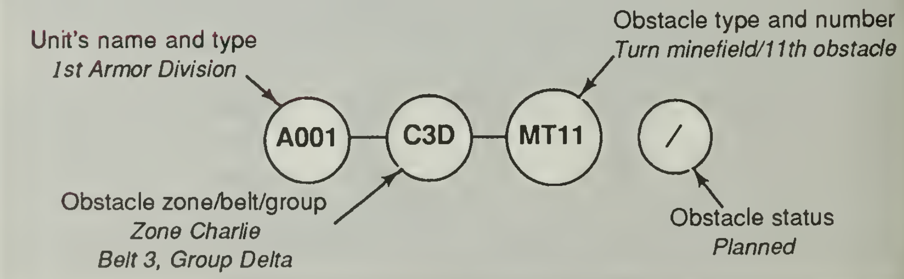
Desert Shield/Storm Oral History Program. Units returning from the Persian Gulf area will participate in an oral history program conducted by DOES. The program is designed to collect information about soldiers' experiences, opinions of the value and importance of equipment, and solutions to issues. Key unit personnel, recorded on tape, will discuss topics such as deployment, combat, administration, and logistical operations.Initial analysis of transcripts and other related documents will be used to determine impacts on engineer doctrine, training, organizations, materiel, and leader development.

Every engineer unit that was in the Persian Gulf will participate. If your unit participated but has not been contacted by DOES, call Vern Lowrey, -5304.

Department of Instruction (DOI)

Obstacle Numbering System. The standard numbering system for obstacles described in Appendix 2 of FM 5-102, *Countermobility*, is obsolete. The new, revised obstacle numbering system shown below will consist of 11 characters and an obstacle status symbol. It will show the type of obstacle, the belt and zone in which it is located, and the headquarters that established the zone. POC is CPT Bob Wray, -5808.

Character	Description
1 through 4	Alphanumeric descriptions of the headquarters type and numerical designation that established the obstacle zone. Character 1 designates the unit type with a letter (A, Armor Division/Brigade; I, Infantry Division/Brigade; C, Cavalry Division; R, Cavalry Regiment; and Z, Corps).
5	Letter indicating obstacle zone.
6	Number indicating belt number in obstacle zone.
7	Letter indicating group in obstacle belt.
8 and 9	Letters indicating obstacle type.
10 and 11	Two numbers indicating obstacle number in the group.
12	One of four characters indicating obstacle status: / (slash = planned obstacle. – (dash) = obstacle being prepared. + (plus) = prepared obstacle. The + is for reserve demolition targets and may indicate a readiness state of safe or armed. X ((X) = completed obstacle.



Obstacle type abbreviations:

B - Bridge demolition (demo)
- BA - bridge demo, abutment
- BS - bridge demo, span
- BC - bridge demo, combination of abutment and span

M - Minefields
- MD - minefield, disrupt
- MT - minefield, turn
- MF - minefield, fix
- MB - minefield, block
- MN - minefield, nonstandard
- MP - minefield, protective
- MQ - minefield, nuisance
- MS - minefield, standard pattern

R - Road crater
- RH - road crater, hasty
- RD - road crater, deliberate
- RM - road crater, mined

W - Wire obstacles
- WA - wire, double apron
- WB - wire, obstacle with booby traps
- WF - wire, tangle foot
- WG - wire, GPBT
- WN - wire, nonstandard
- WR - wire, road block
- WT - wire, triple standard

S - Scatterable minefields
- SA - FASCAM, ADAMS
- SP - FASCAM, PDM
- SG - FASCAM, GEMSS
- SB - FASCAM, GATOR
- SR - FASCAM, RAAMS
- SF - FASCAM, ADAMS and RAAMS
- SM - FASCAM, MOPMS
- SV - FASCAM, VOLCANO
- SW - FASCAM, WAM

Miscellaneous
- AD - antitank ditch
- AR - rubble by CEV gun
- AB - rubble by blade
- AT - abatis
- AE - rubble by explosives
- AM - movable MOUT obstacle (car, bus, etc)
- AN - expedient nonstandard
- AL - log crib
- AP - post obstacles (hedgehog, tetrahedron)
- AH - log hurdles

Example: Obstacle number I005-A2A-SM21/ indicates the 5th Infantry Division planned the obstacle in zone A. It is the 21st obstacle in group A, belt 2, and has not been executed. The obstacle is a MOPMS.

Engineer Personnel Proponency Office (EPPO)

Civilian Proponency. EPPO has assumed proponency for employees in engineer wage grade career fields. The proponent will serve as an advocate for personnel management issues and life-cycle activities. An article explaining the program will appear in a future issue of *ENGINEER*. POC is Cynthia Matthews, -6341.

Functional Area Designation Process. The functional area (FA) designation process is underway for all year group (YG) 86 officers. By now, YG 86 officers should have returned an FA preference marksense form to Engineer Branch, PERSCOM. EPPO has provided a desired FA designation plan to Department of Army. Nominally, about 50 percent of YG 86 engineer officers will receive FA designations; the rest will be single-tracked as engineers. Results are expected by January 1992. POC is Rita Price, -5351.

Rear Guard at Kunu-Ri

By Dr. James W. Dunn

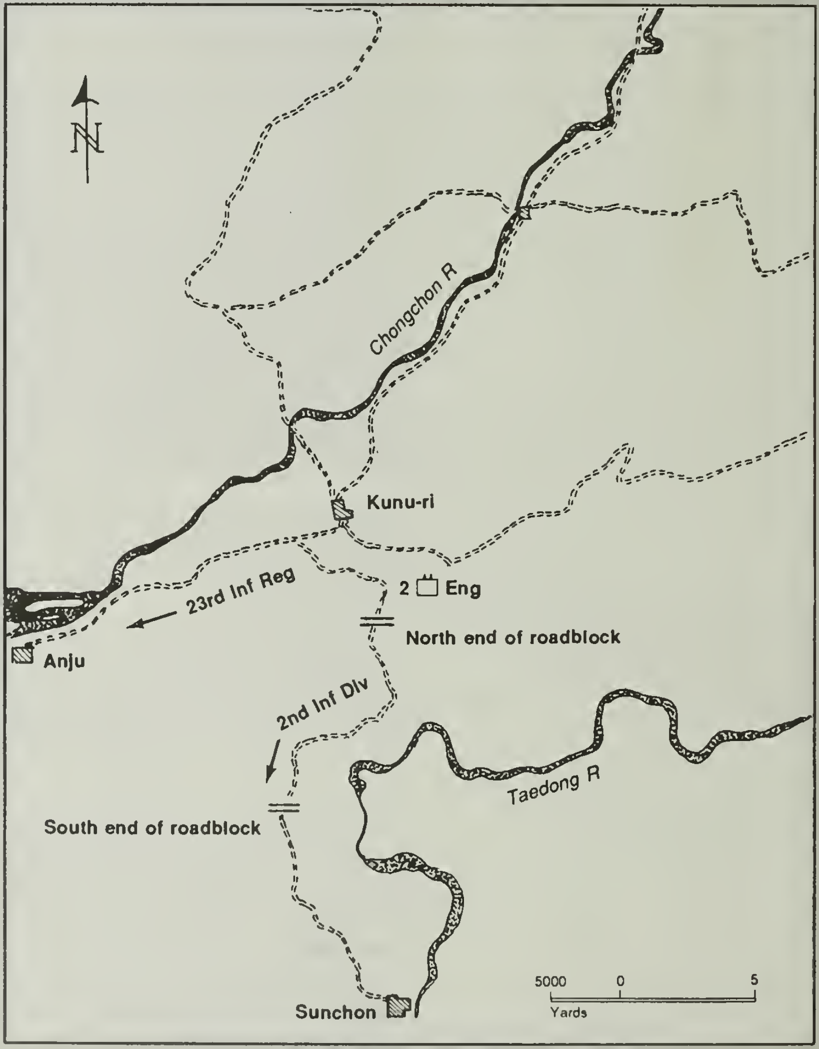
In late November 1950 the American Eighth Army, and the 2nd Infantry Division in particular, suffered a resounding defeat when Chinese forces attacked south across the Chongchon River in North Korea. Most accounts of that action credit either infantry or artillery elements of the 2nd Infantry Division with carrying out the missions of a rear guard during the critical November 30 withdrawal from Kunu-ri. In reality the rear guard at Kunu-ri was the 2nd Engineer Combat Battalion. How that came to be and what happened to the 2nd Engineers is the thrust of this article.

In the fall of 1950, the United Nations Command moved north across the 38th parallel to complete the destruction of the North Korean Army and to unify the country under the government of South Korea. The offensive carried the Eighth Army deep into North Korea. On October 25, Chinese forces attacked forward elements and forced a withdrawal south to positions astride the Chongchon River, some 50 miles north of Pyongyang, North Korea's capital. After a period of recovery, Lieutenant General Walton Walker, commander of the Eighth Army, determined they were ready to resume the offensive on November 24, the day after Thanksgiving.

The mountainous terrain of North Korea made movement and coordination difficult for a mechanized force such as the Eighth Army. Roads were narrow and gravel-surfaced, and had steep grades. In late November the first snows fell, and a brisk northern wind made it bitterly cold. As temperatures dropped, vehicles and weapons failed to function, and the troops suffered from frostbite.

While the North Korean Army had been all but destroyed, the Chinese Peoples Liberation Army posed an unknown threat to the attacking Eighth Army. Estimated at about 50,000, the Chinese opposite the Eighth Army actually numbered more than 200,000 men. They were poised to conduct a mobile defense geared to invite penetration, and then to counterattack with an aim of complete destruction.

The Eighth Army planned to conduct a phase-line controlled, corps-in-zone advance to the northern border, with I Corps on



Map of the Kunu-Ri, Sunchon area, Korea

the left, IX Corps in the center, and the Republic of Korea II Corps on the right. In the IX Corps zone, the 2nd Infantry Division was to attack north in the Chongchon river valley toward Kunu-ri. This kind of methodical advance usually assured close coordination among major units. However, the mountainous terrain made communications difficult, and the campaign developed into a series of battalion-level actions.

Kicking off the attack on November 24, the 2nd Division had the 9th Infantry Regiment on the left, the 38th Infantry Regiment on the right, and the 23rd Infantry Regiment in reserve. They reached a line 20 miles north of Kunu-ri by late afternoon on the 25th. The 2nd Engineer Combat Battalion had a company with each of the two attacking infantry regiments, while the rest of the battalion remained under division control. The engineers were busy keeping roads open and constructing fords across the Chongchon River.

In an attack that night, the Chinese virtually destroyed a battalion of the 9th Infantry and a company of the 38th Infantry. The next morning, the division commander attached Company C of the 2nd Engineers to the 38th Infantry and the rest of the battalion to the 9th Infantry for use as infantry.

As Chinese pressure mounted, the 2nd Infantry Division gradually withdrew toward Kunu-ri. In a strong attack against the 9th Infantry on November 27, the Chinese overran the 2nd Engineers' command post. They moved to Company D's position to continue the fight.

By November 29 the Chinese had stymied the entire American-led offensive, and Eighth Army ordered a withdrawal south to Sunchon. It detailed the 2nd Division as a rear guard to hold at Kunu-ri until November 30. In preparation for the withdrawal, the division relieved its engineers from attachment to the infantry regiments, and the battalion moved to a position near the division command post, just south of Kunu-ri.

That same day the command post received reports that Chinese were on the road to Sunchon, threatening to cut the withdrawal route. Attempts by company-sized units to clear the road were unsuccessful, so Division Headquarters ordered the 9th Infantry to attack on the following morning. The 2nd Engineers were ordered to occupy a ridge just south of the command post. They were to hold it until all elements of the division, except the rear guard of the 23rd Infantry, had cleared south on the road to Sunchon.

The division withdrawal plan for November 30 had the attacking 9th Infantry in front, followed in turn by the 38th Infantry, Division Headquarters, artillery battalions, 2nd Engineers and, finally, the 23rd Infantry as rear guard. But when the 9th Infantry attack failed to clear the road and the 23rd Infantry reported increasing Chinese pressure, Division ordered the 38th Infantry to lead a fighting withdrawal and blast open the road south to Sunchon.

At 1300 the 38th Infantry started south along the road. It passed through the Chinese block position, but following units had

Combat engineers place satchel charges on a bridge near Pyongyang, Korea, during the winter of 1950 (U.S. Army photo).

Combat engineers serving as infantry in Korea in the winter of 1950. Snow and bitter cold caused vehicles and weapons to malfunction (U.S. Army photo).

trouble. By mid-afternoon the Chinese had closed the road again, blocking the withdrawal of division headquarters and the leading artillery battalions. Air strikes helped clear the way, and as darkness fell the stalled units began to move south.

At 1500 the Chief of Staff authorized the engineer battalion to assemble and follow the artillery in the withdrawal column. This proved to be Division Command's final contact with the 2nd Engineers. Headquarters personnel began to move off the ridge in preparation for the move south, but the remainder of the battalion stayed in the defensive position. At the same time the 23rd Infantry, feeling pressure from the Chinese and increasingly concerned about the security of the withdrawal route, asked the assistant division commander for permission to begin withdrawing. They proposed using an alternate route west through Anju. Their withdrawal was approved, but nobody told the 2nd Engineers. When the 23rd Infantry pulled out, the engineers were the northernmost troops in position between the withdrawing 2nd Division and the attacking Chinese. As darkness fell, they stood alone as the rear guard.

By the time engineer headquarters personnel got in the withdrawal column behind the last artillery units, about 1930, all three infantry regiments, division headquarters, and some of the artillery battalions had successfully withdrawn. Darkness and the Chinese caught the engineers and artillerymen on the road. They took to the hills and walked south to Sunchon.

The rest of the 2nd Engineers stayed on the ridge to hold it, as ordered, until all elements of the division had cleared south on the road to Sunchon. They were still there when the Chinese overran the position about 2000. Their story is incomplete because all records were lost during the withdrawal. Division artillery staff officers confirmed that, as the artillery was withdrawing, the engineers were still there as the rear guard.

These engineers paid a heavy price, suffering one of the highest casualty rates in all of the Eighth Army during the Chinese offensive. At Sunchon on December 1, the 2nd Engineers, which had an authorized strength of 977, counted an actual strength of 266. The S-2 was in command of the battalion. The battalion commander, executive officer, S-1, S-3, S-4, and four company commanders had been lost in the fighting, as had almost all of the battalion's equipment. The 2nd Engineer Combat Battalion merits recognition for the sacrifices it made in November 1950, when it served as the rear guard at Kunu-ri.

Additional Reading:

Mossman, Billy, *Ebb and Flow*, November 1950-July 1951, *U.S. Army in the Korean War*, U.S. Government Printing Office, 1990.

Appleman, Roy E., *Disaster in Korea*, Texas A&M University Press, College Station, 1989.

Dr. James Dunn is chief, Studies and Analysis Division, Office of History, USACE.

BRIDGE THE GAP

By Command Sergeant Major Richard N. Wilson
U.S. Army Engineer School

> *"Training is the Army's top priority. It prepares us to fight. As leaders our sacred responsibility is to ensure that no soldier ever dies in combat because that soldier was not properly trained."*

This introduction to FM 25-101 by General Vuono, our former Chief of Staff, captures the essence of noncommissioned officer (NCO) responsibility. Our first and foremost responsibility is to train soldiers in all aspects of their military occupational specialty (MOS) skills and to further develop them in the whole soldier concept.

The NCO Corps is responsible for training the individual tasks and most of the collective tasks in unit training plans. To do this effectively, NCOs must first provide input to their unit's training schedule. After the training schedules and plans are developed, NCOs in each organization must be allowed time to train. A plan that looks good on paper, but which doesn't provide enough resources or protected time to train, has little chance of succeeding.

"Sergeant's time" is a great tool when it is properly used. In many units, however, sergeant's time is simply placed on the schedule. If left there, it provides little to that organization's training posture. Sergeant's time becomes a beneficial tool only when an NCO uses the time for planned, quality training needed by the squad or section.

The NCO is the principal person responsible for making sergeant's time a success. He or she must ensure that training is planned, rehearsed, conducted to standard, and retrained as necessary. But he cannot work alone. The chain of command must back the program by providing the resources and emphasis that will allow the NCO to perform his principal mission as a trainer.

The fielding of new equipment and organizational changes challenge Engineer Corps NCOs to continually revise their training plans. For example, when complex equipment like the M9 ACE is fielded, NCOs must develop and provide training on how to operate and maintain it. Changes in organization, such as the development of engineer brigades in heavy divisions or the manner in which we will fight in a new organization, require that we teach these unfamiliar concepts at the unit level and in the Noncommissioned Officer Education System.

In addition to these changes, several MOS restructuring initiatives now underway will affect how we develop and train engineer soldiers. An example is the 12-series MOS. Upon implementation of this initiative, we will no longer have 12B (combat engineer) and 12C (bridge crewman) as separate MOS. The two will be consolidated into a 12A (sapper) MOS, and 12A soldiers will become responsible for all aspects of the 12B and 12C MOS tasks through all skill levels. This consolidation is tentatively set for fiscal year (FY) 1994.

The 12F (engineer tracked vehicle crewman) series MOS was restructured when the M9 ACE was fielded. ACE operators are now part of the 12F MOS, as are operators of the CEV and the AVLB for skill levels 1, 2, and 3. At skill level 4, 12F MOS soldiers are programmed to merge into the 12A (sapper) MOS.

This means that, starting in FY 94, a 12A sapper platoon sergeant must be knowledgeable in all aspects of what are currently 12B, 12C, and 12F skills. This will be quite a challenge.

Other MOS are being evaluated for possible consolidation. For example, portions of Career Managment Field 51 (general engineering) may be combined.

Initiatives such as these will require that soldiers in the NCO Corps become more knowledgeable and better trained over a wider spectrum of engineer tasks than they are now. In addition, much of the training currently done in one station unit training and advanced individual training will shift to the soldier's individual unit. Thus, NCOs can expect assignments with great diversity.

As the Army's engineer corps shrinks, we must ensure our NCOs are the highest caliber trainers we can develop. We must select only the best soldiers to become NCOs, and then expend great effort and time developing the skills and attitudes they will need for retention and advancement in the NCO Corps. We must train these soldiers so they are prepared to replace us senior NCOs, and can continue to meet Corps' missions with confidence and pride.

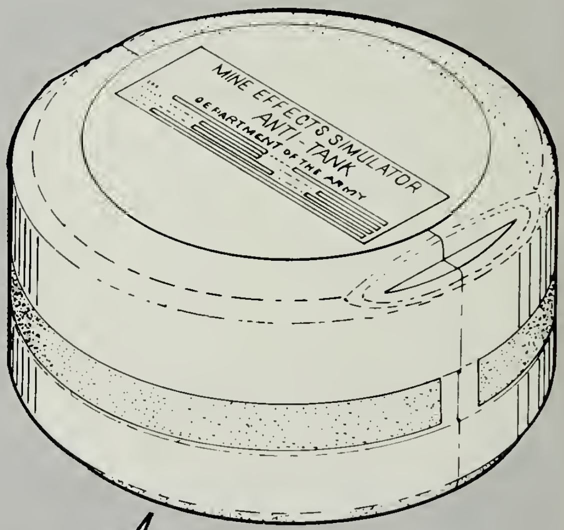
DEPARTMENT OF THE ARMY
ENGINEER PROFESSIONAL BULLETIN
US ARMY ENGINEER SCHOOL
ATTN ATSE-TDM-PB
FORT LEONARD WOOD, MO 65473-6650

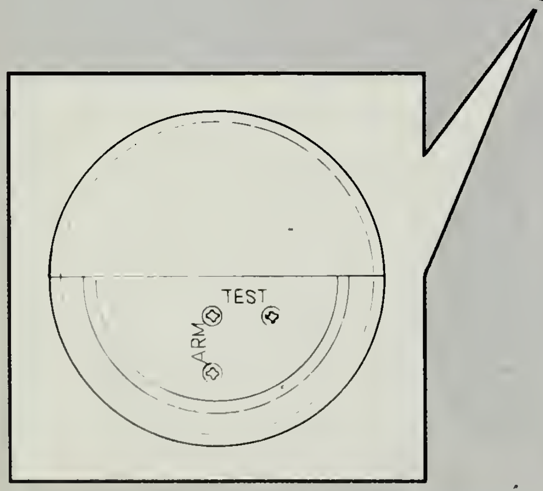
USPS 522-390
OFFICIAL BUSINESS

SECOND CLASS MAIL
POSTAGE AND FEES PAID
DEPARTMENT OF THE ARMY
[illegible]

MINE EFFECTS SIMULATOR

Miles II/Radio Frequency Training Mine
M74 (AP)/M75 (AT)
GEMMS/FLIPPER mines





Weight: 3.39 pounds

To be fielded to the Combat Training Centers beginning in FY 92

BOUND BY
HNM
3-93

UNIVERSITY OF ILLINOIS-URBANA
358.205EN C001
THE ENGINEER$FORT BELVIOR
20-21 1990-92(BD W/O V.20:4)
3 0112 007206599